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Firm Locational Decisions

A Qualitative Choice Analysis

M. F. Petrulis

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ABSTRACT

A multinomial logit analysis was used to explain firm locational decisions in selected electrical machinery industries. Such information can be invaluable to policymakers concerned with rural development decisions. The results indicate that the probability of closure or new start increases if the establishment is a small, multi-unit operation; the probability of contraction increases if the establishment is a large, single-unit operation. The study also shows that demand conditions, local wage rates, construction costs, and the opportunity cost of capital affect the probability of establishment starts, relocations, and expansions and contractions. Business taxes are not important.

Keywords: Qualitative choice, multinomial logit, industrial location decisions, starts, closures, relocations, stationary establishments, opportunity cost of capital, electrical machinery industry.

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HIGHLIGHTS

The research described in this study is designed to explain the location of industrial activity and to test for the significance of selected economic factors which may influence industrial locational decisions. Information on the determinants of firm locational decisions can be invaluable to policymakers in formulating public policy strategies for encouraging the development or revitalization of economically depressed rural areas.

The study takes advantages of a recently available firm micro data set from the Dun and Bradstreet Corporation's "Market Identifier" files to model firm locational decisions within a qualitative choice framework. A multinomial logit model is specified to account totally for the locational activity of individual business establishments. The primary interest is to determine the effects of establishment characteristics and attributes of alternative location sites on the selection probabilities for such locational processes as establishment starts, closures, relocations, contractions, and expansions.

Although the study focuses on firm locational decisions in selected electrical machinery industries, the results should have general industrywide applicability. The results indicate that establishment size and ownership structure are important determinants of firm locational decisions. The probability of a closure or of a new start increases if the establishment is a small, multi-unit operation; the probability of a contraction increases if the establishment is a large, single-unit operation.

This study also shows that certain economic factors influence firm locational decisions. The results indicate that demand conditions, local wage rates, construction costs, and the opportunity cost of capital to the industry affect the probability of new establishment starts and relocations and also that of expansions and contractions in existing establishments. Business taxes, however, do not appear to play a role in firm locational decisions. And, local wage rates and the opportunity cost of capital are not important factors for establishment closures, at least in the electrical machinery industries.

The results suggest that locational decisions can be successfully modeled in a qualitative choice framework if appropriate firm micro data are available.

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INTRODUCTION

Planners and policymakers confronted by decline and geographic redistribution of basic industry in the United States have become interested in the factors that appear to motivate business executives to close, start, relocate, and maintain operations in given local areas, States, or regions. The study of factors which determine the spatial distribution of industrial activity has received relatively little attention in the research literature. This neglect can be traced to the lack of comprehensive data on individual business establishments and possibly to improper model specifications for analyzing the underlying dynamics of industrial growth and change.

In the absence of comprehensive data on individual business establishments, most industrial location studies have relied on information from surveys or national censuses of economic activity. Use of these data has obscured the underlying dynamics of the industrial change process, such as the expansion, contraction, start, demise, or movement of business establishments. Since industrial development policy typically is aimed at influencing the behavior of individual firms, a better understanding of firm output and location decisions and their determinants is needed. This understanding is especially needed for determining which policies are likely to be effective in attracting new establishments to an area and which policies are likely to be effective in assisting existing establishments to expand and prosper.

The research described in this study is designed to help explain changes in the location of industrial activity and to test for the statistical significance of selected factors which may influence these changes. Profit maximization is used as the conceptual base for identifying variables which influence the spatial distribution of industrial activity. Firms are assumed to make output and concomitant location decisions in order to maximize profits. It is hypothesized that such decisions are influenced by the economic attributes of alternative location sites and by the characteristics of the individual decision-makers.

The research is based on data for individual business establishments in the Dun and Bradstreet Corporation's "Market Identifier" files. These files provide information on the individual establishment's location, size, ownership affiliation, industrial classification code, and other selected attributes. Merged annual files allow the tracing of the behavior of a large sample

of individual establishments and the identification of which of these establishments have either recently started, relocated, closed, expanded, or contracted operations. In the present study, these data are used to identify the components of industrial change (starts, closures, relocations, expansions, and contractions) during 1969-75 for five electrical machinery industries. The associated location or output decisions are then modeled within a qualitative choice framework.

A qualitative choice framework was selected for the analysis since the output or location decision may be more conveniently interpreted as a discrete or qualitative choice rather than as a quantitative adjustment. That is, choices are made from a limited number of mutually exclusive possibilities or alternatives where the alternatives are discrete or quantal: one starts a business or one does not; a firm either relocates an establishment or it does not; or, a stationary establishment is either closed, expanded, contracted, or maintained at the same level of output. We assume that a firm decisionmaker chooses a specific alternative for each establishment and that the choice depends upon the characteristics of the alternatives and the attributes of the firm's business establishments.

To fully account for the locational activity of individual business establishments, a multinomial logit model is specified and calibrated. The primary objective is to estimate the effects of establishment characteristics and attributes of alternative locations on the selection probabilities for such output and locational processes as establishment starts, closures, relocations, contractions, and expansions. Establishment characteristics are included as dummy variables. They include ownership status, size, and regional location. Attributes of alternative locations are described by continuous variables: the opportunity cost of capital for the industry (a measure of profitability), the local wage rate, industry production scale, construction costs, and business taxes.

This study provides some evidence on the factors which affect the likelihood of specific locational decisions by business establishments. Although the sample of business establishments is limited to five electrical machinery industries, the results should have industrywide applicability.

THEORETICAL BASIS FOR ANALYSIS OF FIRM LOCATIONAL DECISIONS

Spatial profit maximization provides the conceptual base for identifying variables which influence industrial location choices. The basic form of the neoclassical location theory of the firm assumes that a firm selects that location and level of output for its operation which will maximize its profits. The firm, with a production function that gives it a limited range of alternative ways of combining inputs and producing outputs, will prefer those locations which improve profits: areas with low cost and high demand. The firm can be viewed as weighing the desirability of alternative locations since the terms on which labor and other inputs are available and outputs can be disposed of will be more favorable in some locations than in

others. To minimize the difficulties of assembling data, a partial equilibrium framework is used. This allows us to focus on a few of the most important relationships while others are taken as given.

Derivation of Estimable Relationships

Production

To derive a supply function for output, a production function is necessary. Let output for an industry in a region be described by an aggregate Cobb-Douglas production function 1/

$$Q = K^{a}L^{(1-a)} \quad (0<a<1) \tag{1}$$

where Q is output, K is capital, L is labor, and (a) and (1-a) are the respective elasticities of production with respect to capital and labor. Following neoclassical convention, we assume that the stock of labor is composed of the supply of workers, L, multiplied by the rate of technical progress, e^{gt}, a cost-reducing technology. That is,

$$L(t) = L_{o}e^{gt}. \tag{2}$$

Regarding Q, K, and L as a function of time and substituting (2) into (1)

$$Q(t) = K(t)^{a}L(t)^{(1-a)}e^{(1-a)gt}. \tag{3}$$

The stock of capital and labor and the technology used during the period, t, produces a flow of output during the period. Assume also that the owners of capital are paid the real marginal product of capital and that workers are paid the real marginal product of labor. Technical progress is disembodied from capital accumulation and continues exogenously at rate g.

Differentiating the natural logarithm of (3) with respect to t, we obtain the percentage rates of growth, indicated by asterisks,

$$Q^{*} = aK^{*} + (1-a)L^{*} + Ln(1-a)g. \tag{4}$$

Equation (4) states that the growth of output is positively related to the growth of capital and labor, and to the exogenous rate of technical progress.

Labor Demand

In the neoclassical growth model all factors are fully employed since the demand for output is assumed to be infinitely elastic. Engel [11] points out that while it may be reasonable to assume that capital stock is fixed in the short run, it is unreasonable

1/ A more realistic specification would be the CES production function. However, a Cobb-Douglas production function provides similar results and it is often supported by empirical evidence. See e.g., Nerlove [19].

to assume that employment is fixed in the short run. Firms presumably hire more labor in good times and when the price of labor is low.

The demand for labor is a derived demand for a variable factor of production. The labor demand function for an industry in a specific region can be specified as

$$L = L(Q, \frac{W}{P}) \qquad (5)$$

where L is employment, Q is output, and W/P is the real labor cost to that industry. Assuming that there are numerous firms in an industry, profit maximizing conditions state that the firm will hire workers until their marginal product equals their wage. From the production function, the marginal product of labor can be stated as

$$\frac{\partial Q}{\partial L} = (1-a)(\frac{Q}{L}). \qquad (6)$$

Setting the marginal value product of labor to the wage rate in the industry, we have

$$W = P(1-a)(\frac{Q}{L}) \qquad (7)$$

where P is the price of goods produced by the industry in a region.

Regarding W, P, Q, and L as a function of time, t, we have

$$W(t) = P(t)(1-a)\frac{Q(t)}{L(t)} . \qquad (7a)$$

Differentiating the natural logarithm of (7a) with respect to t, we obtain the proportionate rates of growth

$$L^* = Q^* - (W^* - P^*) + Ln(1-a). \qquad (8)$$

Equation (8) states that the growth of demand for nominal labor is positively related to the growth of output, Q^*, but is negatively related to the growth in price of labor, W^*.

The expansion of employment in an industry will require the hiring of a mixture of occupations where each occupation commands a different wage. Data availability makes it necessary to assume that relative occupational wages in a region are fixed and that the wage of the "mixed" worker is proportional to a basic wage such as for total workers in the industry.

Investment

It is assumed that entrepreneurs survey a variety of locations and choose to invest in the one which offers the highest profit

opportunity. 2/ The net capital movement into a region can, accordingly, be specified as

$$I = I(R_i, R_j) \tag{9}$$

where R_i is the rate of return to capital in the region and R_j is the rate of return elsewhere. That is, R_i represents the rate of return to capital in the rival area for industry location (e.g., neighboring SMSA's or States).

From the production function and profit-maximizing conditions, the marginal product of capital can be stated as

$$\frac{\partial Q}{\partial K} = a(\frac{Q}{K}). \tag{10}$$

Setting the marginal value product of capital to the rate of return to capital, we have

$$R = Pa(\frac{Q}{K}). \tag{11}$$

Regarding R, P, Q, and K as a function of time, t, we have

$$R(t) = P(t)a\frac{Q(t)}{K(t)}\ . \tag{11a}$$

Differentiating the natural logarithm of (11a) with respect to t and letting r be the opportunity cost of capital for the industry in the region i (i.e., $r_i = R_j/R_i$), we obtain the proportionate rates of growth

$$r^* = Q^* - K^* + Ln(a). \tag{12}$$

Equation (12) states that entrepreneurs will invest until the marginal physical product of capital is equal to r^*.

Demand

A demand function for the industry's output in the region can be specified as

$$Q = Q(Y,P) \tag{13}$$

2/ The model developed in this paper follows closely that developed by Engel [10, 11]. Engel developed a shortrun disequilibrium model which determines income, employment, prices, and wages for a metropolitan area, given the level of factor supplies. The author introduced an investment supply function, based on the theory of international capital flows, where investment in an open economy was hypothesized to depend upon the opportunity cost of investment with respect to other regions. That is, the level of investment in a region was assumed to depend not only on the marginal rate of return in the region but also upon the rates of return available elsewhere. A model, such as Engel's, which describes entrepreneurs who survey a variety of locations and choose to invest in the one which offers the highest profit opportunities seems to provide an appropriate framework for testing hypotheses regarding firm locational decisions.

where Q is the value added in the industry produced in the region, Y is an income measure for the consumers of the industry's product in the Nation, and P is the price of this good in the national market.

As Engel [11] points out, it is necessary to assume that value added created by an industry can be treated like a product which has a price and a demand curve. This assumption is necessary since data on final products sold in a region do not provide information as to the source of the factor inputs or outputs. The output may have been produced partially in the region or completely in some other region. If the products were produced in some other region, local job creation would be minimal.

A simple specification for the demand function is

$$Q = Y^{b_1} \left[\frac{1}{P}\right]^{b_2} \qquad (14)$$

where Y is an income measure for the consumers of the industry's product (a measure of the national market) and b_1 is the elasticity of the region's production relative to total industry output. 3/ P is the FOB price of goods produced by the industry in the region and b_2 is the price elasticity of demand for the industry's products in the region. Specifying this demand function assumes that transportation costs are not an important locational factor for the specific industries selected for analysis in this paper. 4/

3/ The total dollar output of the industry in the Nation is taken as the measure of the size of the market in order to avoid estimating income elasticities for all goods.

4/ Although transportation costs have long been recognized in location theory as important determinants of industrial location, there is evidence that such costs are no longer of great importance to a large number of light industries. For example, Pred [21] has found a generally negative relationship between value added by an industry and transportation costs as a proportion of total production costs. Lindberg [16] and Harris [12] have shown that a majority of medium- to high-value-added industries confine their plant location to the industrial heartland where transportation costs to markets vary relatively little. More specifically, Smith [24] has found that for electronic equipment, a high-value-added industry, a region of low transport costs extends over half the United States, from the manufacturing belt to the Middle West. In this region, freight rates vary less than 16 percent above minimum transport cost location. More important perhaps, the national input-output tables [32] indicate that transport costs may be an insignificant proportion of total costs for each of the five electrical industries selected for analysis in this paper. For example, transport costs as a proportion of total costs ranged from 1 percent (electronic systems and equipment) to only about 2 percent (lighting fixtures) in 1972.

Regarding Q, Y, and P as a function of time, t,

$$Q(t) = Y(t)^{b_1} \left[\frac{1}{P(t)}\right]^{b_2} \tag{14a}$$

and differentiating the natural logarithm of (14a) with respect to t, we obtain the percentage rates of growth

$$Q^* = b_1 Y^* - b_2 P^*. \tag{15}$$

Equation (15) states that the demand for the industry's product in the region depends upon total income in the Nation and upon the price. Demand will increase if total income (the size of market) increases and it will decrease if the price increases.

Solving the Model

Equations (4), (8), (12), and (15) form the structural model. Since data are unavailable on the price of output from local firms or the amount of output produced, the system of equations can be solved for L in terms of the observable variables Y, W, and r by solving equation (12) for K and then substituting into the production function (4)

$$Q^* = L^* - \frac{a}{(1-a)} r^* + C_o \tag{16}$$

and solving the demand equation (15) for P and substituting into (8)

$$L^* = \frac{(b_2 - 1)}{b_2} Q^* - W^* + \frac{b_1}{b_2} Y^* + \text{Ln } (1-a). \tag{17}$$

Substituting equation (16) into (17) we obtain the reduced form

$$L^* = b_o + b_1 Y^* - b_2 W^* - \frac{a(b_2-1)}{(1-a)} r^*. \tag{18}$$

The reduced form equation (18) specifies the relationship between industry output decisions (in terms of employment) and the attributes of alternative locations. Equation (18) represents an industry output decision model. However, in most industries, there exists some degree of monopoly with some firms not being price takers. If firms in an industry are not perfectly competitive, then an industry model may also be appropriate for modeling individual firm locational decisions. This may be especially true for the electrical machinery industry where some degree of oligopoly exists (table 11, p. 36).

In choosing to model firm location and output decisions within this framework (equation 18), we feel that it makes sense to categorize such decisions in terms of factors which may affect

expected profits. 5/ For example, one could argue that a decision to cease operating a business enterprise involves minimal, if any, profit expectations or potential by the firm decisionmaking unit. On the other hand, a firm may have enough financial resources to have the option to relocate to some other geographic area. This option involves a certain level of expected profits. In this case, a move outside the present local jurisdiction may involve not only changes in tax and expenditure patterns, but also may create various uncertainties regarding the operation of the business. To compensate for these factors, a firm would expect a higher profit potential or rate of return to capital than at the present site. If the expected profits at the present location were higher, there would be no incentive to relocate and the firm would remain stationary. The most drastic endeavor that an entrepreneur can be expected to embark upon is the creation of a new enterprise. This is evident from the low survival rates for new business endeavors. In the latter case, one could hypothesize that the rewards or expected profits at a location should be commensurate with such risk taking.

In specifying the dependent variable, one should ideally specify all possible destinations as a function of the characteristics of the destinations. However, as Akin, Guilky, and Sickles [2] point out, such a specification would make the model computationally intractable unless the number of destinations is small. Thus, it is necessary to assume that our classification of discrete choices of firm locational decisions--starts, closures, relocations, stationary expansions, and contractions--is a reasonable proxy for the inclusion of all possible locations.

The continuous independent variables measure the attributes of alternative location sites for the establishments of each firm. These comprise the opportunity cost of capital (i.e., local rate of return to capital in relation to the rate of return to capital in alternative locations), local wage rates, and industry production scale in the area. Industry production scale is used as a proxy variable to indicate national demand conditions for the output of the industry.

The attributes of individual firms are included as dummy variables. Since the Dun and Bradstreet data set provides information only for a limited number of firm attributes, only three firm attributes are included as dummy variables in the model. These are size of firm, organizational structure of the firm (single-unit operation or branch and headquarters), and regional location. These variables are included in the model on the assumption that they may influence profit calculations that firms engage in.

With more ability to search among a wider range of possible sites and greater access to information, the large firm or a

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5/ In this paper the term "firm" is used in the context of the decisionmaking process concerning an individual plant or establishment.

firm with multi-unit operations may be better able to evaluate potential profits than the small or the single-unit firm. A large firm's location decision consists of evaluating selected revenue and cost information such that the firm can achieve an acceptable level of profits and longrun viability. One can expect the large firm to be more realistic and conservative in estimating potential profits due to locational decisions. Moreover, a multi-unit organization with larger financial resources than a small firm may have the option to subsidize certain operations (plants) in the short run with the expectation that these operations (e.g., through market penetration) will contribute to the firm's longrun profits. The small firm, due to limited financial resources, may not have this option. It may have to terminate operations. Also, the small firm with limited access to information on location factors is more likely to depend on past experience and subjective criteria. In many instances, the small firm may overestimate potential profits associated with locational decisions. This is typified in new firms where enthusiasm is sparked by a new innovation, invention, or a notion that potential demand exists in a particular market. Thus, we hypothesize that large firms and multi-unit operations may evaluate potential profits associated with the respective locational decisions (closures, relocations, starts, expansions, and contractions) differently than would the small or single-unit firms.

Regional dummy variables are included to pick up systematic differences between the South and other major regional markets in factors not accounted for by the other variables. For example, numerous writers in the literature have observed wages to be lower in the South; such differentials are presumably based on difference in the cost of living and the degree of unionization.

Adding attributes of individual decisionmakers to equation (18), the reduced form (Specification A) for explaining firm locational decisions (in terms of employment) is

$$L^*_{k,j} = b_o + b_1 Y^*_{i,j} + b_2 W^*_{i,j} + b_3 r^*_{i,j} + b_4(\mathrm{OWNER}_k) + b_5(\mathrm{SIZE}_k) + b_6(\mathrm{NEAST}_k) + b_7(\mathrm{NCENTRAL}_k) + b_8(\mathrm{WEST}_k). \tag{19}$$

<u>Dependent variable</u>:

$L_{k,j}$ = Employment in establishment k at location j.

<u>Independent variables</u>:

(for computation methodology used for continous variables see the section on measurement of variables, p. 19)

$r_{i,j}$ = Opportunity cost of capital for industry i at location j,

$Y_{i,j}$ = Scale of production for industry i at location j,

$W_{i,j}$ = Wage rate for industry i at location j,

$OWNER_k$ = A dummy variable taking the value 1 if the establishment is a single-unit operation, 0 otherwise,

$SIZE_k$ = A dummy variable taking the value 1 if the establishment has less than 100 employees, 0 otherwise,

$NEAST_k$ = A dummy variable taking the value 1 if the establishment is located in the Northeast United State, 0 otherwise,

$NCENTRAL_k$ = A dummy variable taking the value 1 if the establishment is located in the Northcentral United States, 0 otherwise, and

$WEST_k$ = A dummy variable taking the value 1 if the establishment is located in the Western United States, 0 otherwise.

In addition, business taxes and construction costs are included as potential explanatory variables for industrial location decisions. It was felt that the absence of these variables might produce specification error and thus result in omitted variable bias.

There is disagreement whether State and local taxes can influence industrial location decisions. Evidence in previous studies [9, 18, 23] provides little support for the proposition that taxes influence industrial location decisions; however, there is some indication [1] that high-tax States, New York and Massachusetts in particular, are now taking action to restore their competitive position. Proponents of lower tax rates have argued that taxes are a prompt and available means of reducing business costs and interstate tax differentials can become the "swing" factor in close industrial location decisions. It has also been argued that taxes have a symbolic value to businessmen, e.g., as a pledge of community support, and can encourage firms to expand or start new operations at home rather than elsewhere. This study will try to determine whether State-local taxes with initial impact on business do influence location decisions in the electrical machinery industry.

One universal change in manufacturing technology which has occurred in recent times is the introduction of continuous-material-flow systems and of automatic controls in processing. This has resulted in the growing use of single-story production lines, a phenomenon that significantly increases efficiency and lowers production costs. As existing manufacturing facilities become obsolete or fully utilized, decisionmakers are

often faced with the question of whether to expand production (i.e. increase new capacity) at the present location or to relocate and start new operations on sites which may be more suitable for modern production facilities. An important consideration in such decisions and that for new entrepreneurs could be the relative construction cost differentials. Construction costs are included as an explanatory variable to determine whether firm location decisions are sensitive to such cost differentials.

Adding business taxes and construction costs to equation (19), a new reduced form (Specification B) for explaining firm locational decisions (in terms of employment) is

$$L^*_{k,j} = b_o + b_1 Y^*_{i,j} + b_2 W^*_{i,j} + b_3 r^*_{i,j} + b_4(\mathrm{OWNER}_k)$$
$$+ b_5(\mathrm{SIZE}_k) + b_6(\mathrm{NEAST}_k) + b_7(\mathrm{NCENTRAL}_k)$$
$$+ b_8(\mathrm{WEST}_k) + b_9 T_j + b_{10} C_j \qquad (20)$$

where variables are defined as in equation (19), and T_j = State-local taxes with initial impact on business at location j, and C_j = Construction costs at location j.

STATISTICAL DESIGN FOR A QUALITATIVE CHOICE MODEL

To model the behavior of individual firms with respect to locational decisions, a qualitative choice model is specified in terms of the theory of a representative firm and a stochastic theory of the distribution of deviations from the representative firm. This specification permits not only the modeling of behavioral actions that are qualitative or discrete, rather than continuous in nature, but also the estimation of relationships between firm location and output decisions and attributes of alternative locations or of individual decisionmakers.

Statistical models with qualitative dependent variables belong to a class of models known as "discrete choice models." 6/ These models assume that decisionmakers are faced with a finite set of mutually exclusive alternatives and that the choice they make depends upon the attributes of the individual decisionmakers and the alternatives. For the firm, these alternatives may comprise the decision to close, relocate, start, contract, or expand operations. The primary objective of the qualitative choice models is to find a relationship between a set of attributes describing a firm and/or location and the probability that

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6/ Discrete choice models represent alternative specifications to the linear probability regression model. The use of ordinary least squares in estimating a linear probability function creates several difficulties. The assumptions for estimation are violated since a discrete dependent variable implies that the underlying disturbance term is heteroscedastic. The predicted probability values may fall outside the unit range.

the firm will make a given choice. 7/ The objective is to determine the probability that a given firm with a given set of attributes (i.e. characteristics of the local area in which the firm is located and of the firm itself) will make a specific location or output decision.

One specification of a discrete choice model is the multinomial logit. The multinomial logit attempts to account for all of the locational activity of individual firms, as reflected in the behavior of their business establishments. This model is specified in terms of the proportion of establishments in the industry (sample) which had selected a specific location or output decision, such as start, closure, relocation, contraction, or expansion of operations. The primary interest is to determine the differences in selection (response) frequency of specific locational decisions by establishments in the industry. 8/

Multinomial Logit Model

Suppose that in response to economic conditions prevailing in a particular location there are J possible discrete choices by a business establishment: closure, relocation, start, contraction, or expansion of operations. The establishments are assumed to be drawn from each of the populations in a probability sample and the establishments in each sample are partitioned among the J mutually exclusive choice categories. The choice categories are not assumed to be ordered.

Let $Z_1,\ldots,Z_n$ denote independent (but not identically distributed) observations of the discrete dependent variable, and define

$$P_{i,j} = P(Z_i = a_j) \qquad i=1,\ldots,N \text{ and } j=1,\ldots,J \tag{21}$$

where the response variable for the i-th firm, Z_i, may assume J values. The selection probabilities can be related to the set of exogenous variables, measuring site and establishment attributes as defined in equations (19) or (20), by means of the standardized cumulative multivariate logistic distribution. The multinomial logit can be written as

$$\log_e \left[\frac{P_{ij}}{P_{i1}}\right] = X_i B_j \tag{22}$$

7/ The need to interpret the dependent variable as the probability of making a choice and to predict probabilities for the various possible values of the dependent variable requires the use of a cumulative probability function. A cumulative probability function guarantees that predicted probability values will lie inside the (0,1) interval and maintains the property that increases in the values of the independent variables are associated with increases (or decreases) in the dependent variables for all values of the independent variables.

8/ In the multinomial model, each location process is assumed to have a separate coefficient vector or weighting scheme but the explanatory variables contain no specific information on the attributes of each locational process.

where X_i is the i-th observation vector of explanatory variables and B_j is a vector of unknown parameters for the j-th choice or alternative. 9/ The N-1 equations in (22), plus the requirement that the probabilities for every i sum to one, determine the selection probabilities uniquely. Explicitly, the solution for the ex-ante probabilities is

$$P_{i,j} = \frac{e^{X_i B_j}}{\sum_{k=1}^{J} e^{X_i B_k}} \tag{23}$$

In addition to assuming that the disturbance terms are Weibull distributed, the other main assumptions in this model are: (1) interaction effects of order higher than two are absent; (2) bivariate interaction effects are constant, independent of any explanatory exogenous variables; and (3) main effects are linear functions of any explanatory exogenous variables.

The multinomial logit model is estimated using data from a sample of establishments where each firm is observed to choose from a finite set of alternatives. Since this model represents a nonlinear specification, a maximum likelihood procedure is used for calibration. 10/ This procedure searches for a set of coefficients which maximize the product of the selection probabilities of the chosen alternative of each observation. Since maximizing the product of the probabilities is the same as maximizing the sum of the logarithm of the probabilities, the objective of the calibration is to maximize the "log-likelihood" function.

The Data

The basic sources of data used to model firm locational decisions are the 1967 and 1972 Census of Manufactures, selected Annual Survey of Manufactures, and the Dun and Bradstreet Corporation's (D&B) "Dun's Market Identifier" files current in 1969 and 1975.

The (D&B) files provide the following information for each manufacturing establishment: (1) most prominent 4-digit SIC code classification of the products of the establishment; (2) employment size; (3) the identification and location of the organization's parent if the establishment is a branch or subsidiary; (4) geographic information such as zip code, city, county and State; (5) year of formation of establishment; and (6) a "DUNS" number which is constant for any establishment through time. The "DUNS" number, identifying an establishment, is never reissued and remains in the data file as long as the establishment exists and doesn't change its legal status. Since the "DUNS" number is

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9/ For a complete derivation of the multinomial logit specification, see Nerlove and Press [20].
10/ See e.g., Avery [4].

never reissued, it is possible to trace the location history of any particular establishment by matching establishments in the data files for each of the 2 years. This matching can identify stationary establishments (establishments in business at the same location throughout the study period), starts, closures, and relocations.

The (D&B) data encompass 1969-75. 11/ This period is sufficiently long to permit meaningful analyses since, as Leone [15] points out, the work place location patterns (establishment output decisions) tend to change with great rapidity. Moreover, these are nonrecession years and they bracket the other data sources such as the 1972 Census of Manufactures. 12/

The (D&B) data provide information for about 117,000 manufacturing establishments. Data in this sample appear to be in close agreement with data in the Census of Manufactures and County Business Patterns, especially in the Northeast [7, 15] and in areas with high growth rates [3]. In other areas, the (D&B) data may under- or overstate establishment counts and employment but the share of specific industries is fairly constant [13, 25].

The usefulness of the (D&B) data files for identifying and quantifying the components of economic change has been demonstrated in a number of recent studies of the location process of firms. Some of these studies used (D&B) data to analyze the process of net locational change in employment within selected metropolitan areas [15, 25]; other studies have examined the components of the process for selected regions and States [3, 7, 8, 13, 14].

The procedure for identifying manufacturing establishments that came into existence, closed, remained stationary, or migrated into or out of the selected areas during the 1969-75 period is similar to that used in the studies mentioned above. For example, establishment entries in the 1969 and 1975 (D&B) data files

11/ Historical (D&B) files are available only since 1965. In the current research the most current (D&B) data are used (December 31, 1969 - December 31, 1975).

12/ The 6 year time period chosen for analysis may confound cyclical movements with longer term trends. However, this might not be a serious problem since the study period does begin and end in similar phases of two business cycles (i.e., in the expansion phase) and such aggregates as employees on nonagricultural payrolls and total employee hours worked in nonagricultural establishments show similar growth patterns between the 2 years selected for study [30].

were matched according to their "DUNS" numbers. 13/

For those firms whose "DUNS" number existed in both time periods, the following locational processes were defined:

Same geographic area (county) in 1969 and 1975:

Stationary contraction	An establishment that did not move outside the county but whose employment contracted or did not change during the period,
Stationary expansion	An establishment that did not move outside the county but whose employment expanded during the period.

Different geographic area (county) in 1969 and 1975:

Relocation	The departure from the county of an establishment that was previously located there.

For the establishments whose "DUNS" number existed only in one year, there are two cases:

Starts	The appearance in the 1975 file of an establishment with a new "DUNS" number, for which the year started was 1970-75,
Closures	The disappearance from the 1975 file of an establishment with a particular "DUNS" number. 14/

13/ A matching of establishment records in the 1969 and 1975 (D&B) data files does not guarantee completely an accurate identification of relocations. Some relocations may have been falsely recorded as closures and/or new starts during the period. An example is the case where establishments are acquired by a firm and then consolidated under the new company name at a new location. These establishments would be identified as closures at the old location and then as establishment starts at the new location and not as relocations.

14/ The appearance in the 1975 file of a firm with a new "DUNS" number, for which the year started was before 1969, would be classified as a new listing. Since the Dun and Bradstreet Corp. originally did not survey all the firms in the nation, new listings are added periodically to the data files.

The matching of establishment entries in the two data files indicated both the establishment counts and employment changes associated with relocations, starts, closures, and stationary establishments.

Once the locational processes were identified, the (D&B) establishment data were cross-classified by employment size and ownership status. 15/ Establishments were grouped according to whether they employed 100 or more or less than 100 employees and whether they were single-unit operations. 16/

Selection of Industries

The electrical machinery, equipment, and supplies industry was selected for modeling firm locational decisions. This is a high technology industry which specializes in the manufacture of industrial electrical equipment, consumer electronic products, electronic systems and equipment, and various electronic components. The industry appears to have a fairly strong final demand orientation and a large market area. In 1972, 49 percent of the industry's output went to final demand users with 65.5 percent of the output being shipped more than 300 miles. 17/ Most of the shipments were made by motor carriers and private trucks (66.9 percent) in units of less than 9,999 pounds.

In 1972, there were 35, 4-digit SIC industries in the electrical equipment and supplies industry. 18/ Five of these industries were selected for study: switchgear (SIC 3613); lighting fixtures (SIC 3642); consumer electronics (SIC 3651); electronic systems and equipment (SIC 3662); and electronic components (SIC 3679). 19/ In choosing these industries for analysis, the following criteria were used:

(1) The industry had to have substantial relocation activity during the time period under study;
(2) the technological characteristics among the industries had to be diverse;
(3) the structure of production had to be fairly homogeneous in the industry; and
(4) the industry had to produce for a national market.

15/ Ownership status refers to whether an establishment serves as a headquarters, branch, or subsidiary establishment, or is a single-unit operation.

16/ In order to obtain sufficient observations for analysis, a small firm (establishment) is defined as having less than 100 employees.

17/ See e.g., Survey of Current Business [31] and the Census of Transportation [29]. The percentage of output being shipped more than 300 miles overestimates the actual percentage because the Census of Transportation does not take in to account the output produced by establishments with less than 20 employees, or locally shipped output.

18/ The Office of Management and Budget developed the Standard Industrial Classification (SIC) as a method for industries to conform with the composition and structure of the economy covering the entire field of economic activities.

19/ See [28] for a detailed description of these industries.

These selection criteria provided a set of homogeneous industries with diverse characteristics in terms of wage rates and value added per unit of labor (table 1). 20/ The set includes both high technology industries such as SIC 3662 and low wage, low value added per unit of labor industries like SIC 3679. All of the selected industries, however, ship their products over long distances and rely primarily on motor carriers and private trucks.

Table 1--General statistics for selected industries, 1972

Industry SIC code	Relocating establishments 1/	Value added per production worker hour	Wage rate per production worker hour	Product shipped over 300 miles	Product shipped by motor carrier 2/
	Numbers	--Dollars--		--Percent--	
3613	21	13.42	4.00	58.4	87.3
3642	32	12.04	3.52	70.3	76.2
3651	17	13.65	3.43	71.7	69.4
3662	56	18.08	4.51	3/ 62.1	3/ 83.6
3679	77	9.77	3.12	48.6	84.8

Sources: Dunn and Bradstreet for relocations; Census of Manufactures [28] for value added, production worker payrolls and man-hours; Census of Transportation [29] for percent of product shipped by motor carrier.

1/ Number of relocations for the period 1969-75.
2/ Includes private trucks.
3/ Percentage refers to the entire SIC 366.

After deleting establishments for which information was incomplete, the data set for the five selected industries comprises 9,160 establishments (table 2). During the 1969-75 study period, 2,846 new establishments came into existence; 203 relocated across county lines; 2,941 closed operations; and 3,170 remained stationary. Among the stationary establishments, 1,544 expanded employment during this period; 1,119 contracted employment; and 507 were reported to have the same employment both in 1969 and in 1975. 21/

20/ The primary product specialization ratio, an indicator of homogeneity in the production structure of an industry, ranged from 82 (SIC 3679) to 91 (SIC 3613 and SIC 3662) and 95 (SIC 3642 and SIC 3651) in 1972 [28].

21/ Stationary establishments which reported the same employment in both time periods were aggregated with establishments which had contracted employment. For analysis purposes, it was assumed that decisions to maintain the same employment during a particular time period are more akin to decisions to contract employment than to decisions to expand employment since the latter decisions involve a greater investment commitment in terms of expanding productive capacity and hiring new employees.

Table 2--Components of change due to stationary establishments, starts, closures and relocations in the electrical machinery industry, 1969-75

Industry SIC code	Total establish-ment	Components of change, 1969-75					
		Closures	Relocations	Stationary			Starts
				Contractions	Stable 1/	Expansions	
	Number						
3613	594	129	21	90	39	117	198
3642	1,103	467	32	195	114	279	16
3651	782	244	17	75	41	102	303
3662	2,683	864	56	272	113	358	1,020
3679	3,998	1,237	77	487	200	688	1,309
Total	9,160	2,941	203	1,119	507	1,544	2,846
	Percent of total number						
3613	100.0	21.7	3.5	15.1	6.6	19.7	33.4
3642	100.0	42.3	2.9	17.7	10.3	25.3	1.5
3651	100.0	31.2	2.2	9.6	5.2	13.0	38.8
3662	100.0	32.2	2.1	10.1	4.2	13.3	38.0
3679	100.0	30.9	1.9	12.2	5.0	17.2	32.8
Average	100.0	32.1	2.2	12.2	5.5	16.9	31.1

Source: Dun and Bradstreet.

1/ Establishment with the same employment in 1969 and in 1975.

Selection of Geographic Areas

The sample of geographic areas comprises 10 States, 29 SMSA's, and 13 residual portions of States. 22/ The latter represent State nonmetro areas and the smaller SMSA's within a particular State. The choice of areas was dictated by availability of capital expenditures data. The perpetual inventory method, used to estimate the stock of plant and equipment assets, required a time series of capital expenditures data. The Census of Manufactures and the Annual Survey of Manufactures do not report such data for all areas or all time priods. The Census withholds data for any SMSA or State if it means disclosing data for individual establishments or if the industry in the area had fewer than 250 manufacturing employees. 23/ In addition, the Annual Survey reports suppress some estimates because of large standard errors. Nevertheless, it was possible to include in the data set the most important SMSA's and States for SIC 36. The selected areas account for 88.8 percent of the total locational activity (i.e., establishment closures, relocations, contractions, expansions, and starts) in the industry during the study period. For individual locational processes, the coverage ranges from 79.5 percent for relocations to 96.9 percent for establishment starts.

Measurement of Variables

The attributes of each location site (i.e. where a business establishment actually was located during the study period) were measured by the set of variables derived in the theory section, above. These comprise the opportunity cost of capital, wage rates, business taxes, construction costs, and scale of production. The scale of production for an industry was measured by value added and capital stock figures were derived for this study by the perpetual inventory method. Capital stock figures were deflated by investment goods prices. Payroll data were adjusted for fringe benefits and employer social security contributions. The specific measurement of variables is described below.

Rate of Return

The calculation of the opportunity cost of capital to an industry required the computation of the marginal value product of capital for an industry in various geographic areas. This could not be done with the data reported in the Census of Manufactures or the Annual Survey of Manufactures. However, if the basic production technology is Cobb-Douglas and all the areas have access to the same technology, then the ratio of the average rates of return between two areas will be equal to the ratio of the marginal rates of return. And, if the CES production function is applicable and the elasticity of substitution is close to unity or the capital-labor ratios do not diverge greatly between areas, the average product of capital will be proportional to the marginal product.

22/ State residual areas comprise the smaller SMSA's and the nonmetropolitan portion of the State. For a description of areas, see Appendix A.

23/ Prior to 1967, detailed data were not reported for SMSA's with under 40,000 total manufacturing employment.

The average rate of return to capital was computed from the data in the Census of Manufactures and the Annual Survey of Manufactures. When computing the average rate of return to capital, R, for an industry, the following definition was used:

$$R = \frac{\text{Value added - Total wage bill.}}{\text{Capital stock}} \tag{24}$$

The difference between value added and the total wage bill is only a surrogate measure of total profits since it includes supplementary labor costs, depreciation charges, State and local taxes (other than corporate income taxes), allowance for bad debts, purchases of advertising, insurance, legal, and other services from manufacturing enterprises, and contract costs involved in maintenance repair.

These costs should be subtracted from value added before the rate of return to capital is calculated. However, except for supplementary labor costs, it is difficult to measure the value of such costs at the regional level. An assumption was made that these costs, except for supplementary labor costs and rental payments for the use of items for which depreciation reserves would be maintained if they were owned by the establishment, remain a fixed proportion of value added (which would be the case if the elasticity of substitution were unity) or that this proportion changes similarly for an industry in different geographic areas. If this assumption is valid, then the surrogate measure of profitability should be highly correlated with the true rate of return or, at least, be indicative of the profit paying potential in an area.

Value added figures were adjusted for supplementary labor costs and rental payments. 24/ These data are available for two-digit industries at the State level in the Annual Survey of Manufactures. State totals for supplementary labor costs and rental payments were allocated to industries in the selected SMSA's according to the distribution of payrolls.

The other component of the rate of return to capital is the capital stock in the industry. To estimate the capital stock in an industry within a specific geographic area, it was necessary to rely on benchmarks for gross book value of depreciable assets and use the perpetual inventory method to generate a series which matches the benchmarks. The perpetual inventory method involved the development of gross investment series over the years, subsequently calculating discards by specific

24/ Supplements to income comprise an employer's contribution to wages and salaries which is not received directly by the employee. This consists of such items as employer's legally required expenditures for employees' Social Security, for programs like pension plans, health benefits, bonuses to salesmen and for any other fringe benefits.

vintage and accumulating the residual values as a perpetual inventory of capital stock measures. 25/

The Census of Manufactures and the Annual Survey of Manufactures report only the 1957 and 1962 book values of depreciable assets for selected industry groupings within the State; however, plant and equipment expenditures for industries are reported on an annual basis for selected States and SMSA's. A surrogate for return on investment to capital value (e.g., value added minus the total wage bill) can be used to allocate the benchmark data to SMSA's. These benchmark data were used in conjunction with the perpetual inventory method (i.e., accumulating annual expenditures for plant and equipment and depreciating them according to the service lives of capital assets) to construct 1967 and 1972 estimates of capital stock for the SIC 36 industry in specific SMSA's.

We assume that entrepreneurs survey a variety of locations and choose to invest in the one which offers the highest profit potential (as measured by the rate of return to capital). However, it can be argued that for most entrepreneurs the alternative location for new investment is the region of origin, and a particular area within that region, and not the Nation as a whole. That is, we hypothesize a location decision process where the entrepreneurs initially select a specific region, e.g., the South versus the North. Having selected the region, the investors then compare alternative locations within that region. For most entrepreneurs, the likely rival location sites are the nearby SMSA's or nonmetro areas of the State. Since data were available only for the larger SMSA's, rates of return were calculated only for these SMSA's, the respective residual portion of each of these States, and also for some selected States.

The opportunity cost of capital for establishment start, closure, expansion, contraction, and relocation processes was determined from the industry rates of return to capital in the area of origin and the nearby rival areas, i.e., the larger SMSA's in the State and in the adjoining States and, in some cases, in the residual areas of these States. 26/ The highest alternative rate of return among rival areas served as the basis for calculating the opportunity cost of capital to the industry.

Production Scale

The scale of production in an industry was measured by the value added created in that industry in each of the selected areas.

25/ For a detailed description of the perpetual inventory methodology, see e.g., [33].

26/ There may be a problem of endogeneity in the model specification since value added was used both for determining the opportunity cost of capital and the production scale. Ideally, an instrumental variable should have been used for the opportunity cost of capital.

Wage Rates

The use of all employees′ payroll data as defined by the Census is not entirely satisfactory for computing the necessary wage rates. The payroll data do not include supplements to income. And, comparable worker hours data are not available. 27/ For one specification of the multinomial logit model, payroll data were adjusted for supplements to income and production worker hours were converted to total worker hours worked. The conversion to total worker hours worked was obtained by multiplying the production worker hours by the ratio of total employment to production worker employment. This assumes that the average work week of nonproduction workers is similar to that of the production workers.

The use of aggregate wage rates by industry may, however, present problems of errors in variables. This possibility exists not so much because of problems in collecting, processing, and presenting of the data used in this study but rather because our data may not reflect accurately the variables suggested by economic theory. For example, there exists the possibility that our aggregate wage variable is correlated with the disturbance term in the multinomial logit model specification. This may lead to estimators which are inconsistent. One solution to this problem is to find either other measures for the wage variable or to use instruments which would satisfy the condition of being uncorrelated with the disturbance term while being correlated with the aggregate wage rate. 28/ Since no adequate alternative measure for wage rates was readily available, we decided to construct an instrumental wage variable for several specifications of the multinomial logit model.

The instrumental wage variable was created by regressing the calculated wage rate (total labor costs per worker hours of

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27/ The Census payrolls figure includes the gross annual earnings of employees on the payroll. It comprises all forms of compensation such as salaries, wages, commissions, dismissal pay, bonuses, vacation and sick leave pay, and compensation in kind, prior to such deductions as employees′ Social Security contributions, withholding taxes, group insurance, union dues, and savings bonds. The total includes salaries of officers of these establishments, if a corporation.

28/ We examined the possibility of using occupational earnings from the Bureau of Labor Statistics′ Area Wage Survey. However, two problems appeared to exist. One problem was the lack of data for some of the geographic areas selected for analysis. A more serious problem existed because wage rate data by occupation were collected only for the larger establishments (50 or more employees in some SMSA′s and 100 or more employees in other SMSA′s) and over a 2-year period (1972 and 1973). During this period, some of the occupation-specific wage rates changed between 1.9 and 12.8 percent across the SMSA′s. Such variation in wage rates may obscure the relative advantage to business in selecting specific location sites.

total labor) on selected explanatory variables

$$W_j = a_o + b_1 POP_j + b_2 POP^2_j + b_3 UE_j + b_4 N_j + b_5 CN_j \quad (25)$$
$$+ b_6 Y_j + b_7 WEST_j + b_8 NCENTRAL_j + b_9 NEAST_j + u_j$$

where

W_j = 1972 wage rate at location j,

POP_j = 1970 population per square mile at location j,

POP^2_j = 1970 population per square mile at location j, squared,

UE_j = 1972 unemployment rate at location j,

N_j = 1972 employment in the electrical machinery industry at location j,

CN_j = 1967-72 employment change in the electrical machinery industry at location j,

Y_j = 1970 median family income at location j,

$WEST_j$ = A dummy variable taking the value 1 if location j was in the Western United States, 0 otherwise,

$NCENTRAL_j$ = A dummy variable taking the value 1 if location j was in the Northcentral United States, 0 otherwise,

$NEAST_j$ = A dummy variable taking the value of 1 if location j was in the Northeast United States, 0 otherwise, and

u_j = Disturbance term,

and letting the predicted value of W_j represent the instrument for the wage rate.

In deriving the instrumental variable for wage rates, we included both supply and demand side components as possible explanatory variables for wage rate differentials. Population density rather than area population was selected as a measure of agglomeration economies (and/or diseconomies) because the former measure applies more closely to regional data and is also associated more with the pecuniary and nonpecuniary costs of city life. In general, we expect higher returns to labor in the more densely populated areas because of higher labor productivity due to agglomeration economies (e.g., availability of a highly trained labor force) and the concentration of social overhead capital; the tendency for a higher percentage of the labor force to be unionized; and the possibility that workers may require a higher wage in such areas to compensate them for cost of living

differences and the disutility of increased crime rates, pollution, and congestion. A quadratic term (population density squared) was also included as an explanatory variable to account for the possibility of agglomeration economies or diseconomies beyond a certain level of population density. For example, economies may exist in transportation and communication in the most densily populated areas with the result that the benefits from agglomeration may offset congestion costs.

The unemployment rate, industry employment, and employment growth were used to represent labor market conditions. According to the Phillips Curve Hypothesis, money wage changes are purported to be inversely related to excess demand for labor as measured by the unemployment rate. That is, high unemployment rates are supposed to weaken the bargaining power of labor in wage negotiations.

Industry employment in an area was included as a possible measure of localization economies which should be reflected in higher renumeration to workers. This variable may also pick up unionization effects since areas with high concentrations of industry employment tend to have relatively large percentages of their labor force unionized. Industry employment growth was selected as an explanatory variable for wage rate differentials since rapidly growing industries may bid up wages.

Median family income in the area and regional dummy variables were also included as possible explanatory variables for wage rate differentials. High-income levels in a particular area, especially where they reflect high wages, may require employers to pay higher wages than in low-income communities where the standard of living and expectations of the residents are lower. The reason for the inclusion of the regional dummy variables was to pick up systematic differences between the South and the other major regional markets in factors not accounted for by other variables in the regression. Numerous writers in the literature have observed wages to be lower in the South; such differentials are presumably based on differences in the cost of living and the degree of unionization.

The regression (equation 25) explained 63 percent of the variation in the wage rate ($R^2 = 0.63$). 29/ The correlation between the instrumental wage variable and the calculated wage rate was 0.78.

29/ The estimated equation for wage rates was:

$$
\begin{aligned}
W_j = 3.202 &+ \underset{(0.18)}{0.000035}\ POP_j + \underset{(0.18)}{0.00000000263}\ POP^2_j - \underset{(0.58)}{0.079}\ UE_j \\
&+ \underset{(1.07)}{0.00397}\ N_j + \underset{(0.18)}{0.00216}\ CN_j + \underset{(2.23)}{0.000216}\ Y_j + \underset{(1.05)}{0.606}\ WEST_j \\
&- \underset{(0.24)}{0.0669}\ NCENTRAL_j + \underset{(0.29)}{0.0814}\ NEAST_j
\end{aligned}
$$

where the number in parentheses is the t-value of the respective estimated value. The mean of the dependent variable was 5.29 and the standard error of estimate for the prediction equation was 0.59.

Construction Costs

Robert Snow Means Company [22] data for building construction costs were used to measure the construction cost variable. These data provide city cost indexes for average construction costs (material and labor). The indexes are based on construction cost rates as compared to the 30 major cities with U.S. average of 100. These data are not available for some smaller SMSA's, the nonmetropolitan portions of States, or Statewide. In estimating construction cost indexes for States and residual portions of States (smaller SMSA's and nonmetropolitan areas), we made two simplifying assumptions. One assumption is that average construction costs among all SMSA's within the State reflect average construction costs for the State as a whole. A second assumption is that average construction costs among the smaller SMSA's in the State reflect actual construction costs in the residual portion of the State.

Business Taxes

Tax burden on business was measured by the ratio of business taxes to total State and local tax receipts. Business taxes are defined as State and local taxes which have an initial impact on business. The Advisory Commission on Intergovernmental Relations [1] has used this concept to measure for each State-local system the relative reliance on levies that business firms may or may not be able to shift to consumers or employees.

Taxes with an initial impact on business consist of several distinguishable elements such as:

(1) general levies, like the property tax on business property, and the retail sales tax as it applies to purchases by business for its own use or consumption;

(2) specific levies such as corporation and unincorporated business income taxes and gross receipts business taxes on the entire gamut of business activities and occupations;

(3) Michigan's single business (value added) tax;

(4) capital stock taxes;

(5) license taxes on business; and

(6) taxes on particular activities, such as severance of minerals, insurance underwriting, banking, and public utility services.

Data on State and local taxes which have an initial impact on business were obtained from the Advisory Commission on Intergovernmental Relations for each State and were used to measure the business tax variable.

STATISTICAL ANALYSIS

A Multinomial Logit Analysis of Firm Locational Decisions

The statistical results of the multinomial logit analysis of firm locational decisions are shown for each of the five industries in tables 3-7. Equations in these tables measure the effects of firm characteristics and attributes of alternative locations on the selection probabilities for establishment starts, closures, relocations, contractions, and expansions. Firm characteristics are included as dummy variables and comprise ownership status, size, and regional location. Attributes of alternative locations are represented by continuous variables comprising the opportunity cost of capital, industry production scale, wage rate, construction costs, and State and local taxes with an initial impact on business.

Various specifications of the model (equation 23) were tested by using both 1967 and 1972 data (absolute levels and changes) for most of the continuous explanatory variables and different definitions of the wage rate and opportunity cost of capital. Although somewhat similar results were obtained by using data for either of the two time periods, the best results, in terms of hypothesized relationships and statistical significance, were obtained when the continuous variables were measured with 1972 data. 30/ Two alternative measures for the wage rate variable were used in estimating the model: total payroll divided by total worker hours of labor and an instrumental variable. 31/ The instrumental variable for wage rates performed much better in terms of verifying expected relationships and providing statistically significant results. 32/ Different reference regions were considered in calculating the local opportunity cost of capital for the industry, i.e., the rate of return in the Nation as a whole, in a census region, and in a census division. The best calibrations for the model resulted when the local opportunity cost of capital was defined in terms of the industry's rate of return in the census division where the establishment was located. Thus, in the final calibrations, business taxes were measured in terms of changes between 1967-77; other continuous independent variables were measured in terms of 1972 data; and local opportunity cost of capital was defined in terms of the industry's rate of return in a census division.

Results for two specifications of the multinomial logit model are reported. Specification A (equation 19) is the base specification where the business tax and construction cost variables

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30/ Data availability necessitated the use of 1972 data for the construction cost variable and the 1967-77 percent change in the ratio of business taxes to total State and local receipts for the tax variable.

31/ For a definition of the instrumental variable for wage rates, see the section on measurement of variables.

32/ Results for the calibration of the model when wage rates are defined as total payroll divided by total worker hours of labor are reported in Appendix B.

Table 3--Multinomial logit estimates and asymptotic t-ratios for the switchgear industry (SIC 3613)

Dependent variable	Specification 2/	Coefficient of: Constant a	Prod. scale b_1	Wage rate b_2	Opp. cost b_3	Owner b_4	Size b_5	North-east b_6	North Central b_7	West b_8	Const. cost b_9	Tax burden b_{10}	Number of observations
Closure	A	-0.649	-0.174	0.079	0.018	-0.216	0.787	0.223	0.174	0.727			129
		(-.34)	(-.98)	(.21)	(.07)	(-.98)	(2.77)	(.72)	(.57)	(1.56)			
	B	-.524	-.225	.171	.053	-.210	.774	.325	.264	.805	-0.647	0.523	129
		(-.25)	(-1.16)	(.40)	(.21)	(-.95)	(2.71)	(.81)	(.64)	(1.64)	(-.33)	(.40)	
Relocation	A	-4.734	-.334	.899	-.530	-.278	-.382	-.598	-.516	-1.276			21
		(-1.22)	(-.89)	(1.19)	(-.97)	(-.62)	(-.80)	(-1.06)	(-.84)	(-1.24)			
	B	-4.360	-.266	.817	-.630	-.285	-.360	-.651	-.499	-1.338	.032	-1.159	21
		(-1.04)	(-.63)	(.95)	(-1.02)	(-.63)	(-.74)	(-.87)	(-.61)	(-1.25)	(.01)	(-.42)	
Stationary contraction	A	1.210	.123	-.145	.280	.445	-.986	.146	.021	-.444			129
		(.63)	(.66)	(-.39)	(.17)	(1.84)	(-3.89)	(.48)	(.07)	(-.84)			
	B	1.419	.233	-.238	.197	.419	-.947	-.001	-.440	-.646	.247	-1.926	129
		(.70)	(1.13)	(-.56)	(.76)	(1.72)	(-3.72)	(-.00)	(-.11)	(-1.17)	(.13)	(-1.45)	
Stationary expansion	A	3.358	.379	-.738	.130	.748	-.525	.486	.531	.384			117
		(1.68)	(2.00)	(-1.85)	(.52)	(2.89)	(-1.87)	(1.44)	(1.69)	(.73)			
	B	3.311	.301	-.651	.202	.768	-.550	.615	.602	.526	-.435	1.218	117
		(1.52)	(1.46)	(-1.47)	(.76)	(2.95)	(-1.95)	(1.45)	(1.46)	(.95)	(-.22)	(.92)	
Start 1/	A	.815	.007	-.094	.102	-.700	1.106	-.257	-.211	.609			198
	B	.155	-.042	-.099	.152	-.693	1.083	-.289	-.323	.652	.804	1.344	198

Note: Asymptotic t-ratios in parentheses.

1/ t-ratios were not computed since establishment starts were used as the normalizing vector.
2/ Log likelihood -825.17 for Specification A and -822.71 for Specification B.

Table 4--Multinomial logit estimates and asymptotic t-ratios for the lighting fixtures industry (SIC 3642)

Dependent variable	Specification 2/	Coefficient of: Constant a	Prod. scale b_1	Wage rate b_2	Opp. cost b_3	Owner b_4	Size b_5	Northeast b_6	North Central b_7	West b_8	Const. cost b_9	Tax burden b_{10}	Number of observations
Closure	A	0.194	-0.061	0.205	0.053	0.283	0.295	-0.439	0.042	-0.195			467
		(.10)	(-.36)	(.54)	(.21)	(1.66)	(1.18)	(-1.39)	(.12)	(-.46)			
	B	.199	-.113	.262	.132	.282	.304	-.233	.109	-.010	-0.336	1.857	467
		(.09)	(-.62)	(.64)	(.49)	(1.65)	(1.21)	(-.56)	(.27)	(-.02)	(-.22)	(1.16)	
Relocation	A	-7.076	-.752	1.347	-1.351	.379	.042	.115	-.307	-.712			32
		(-1.80)	(-2.22)	(1.71)	(-2.16)	(1.03)	(.08)	(.17)	(-.37)	(-.74)			
	B	-8.019	-.613	.766	-1.575	.392	-.060	-.904	-.816	-1.207	4.417	-5.389	32
		(-1.72)	(-1.52)	(.87)	(-2.27)	(1.06)	(-.11)	(-1.04)	(-.93)	(-1.17)	(1.46)	(-1.44)	
Stationary contraction	A	4.338	.391	-.790	.521	.668	-.927	.777	.745	.415			309
		(2.15)	(2.10)	(-1.90)	(1.94)	(3.52)	(-3.78)	(2.14)	(1.86)	(.87)			
	B	5.441	.416	-.602	.511	.671	-.893	1.072	.971	.391	-2.286	-.158	309
		(2.40)	(2.06)	(-1.36)	(1.79)	(3.53)	(-3.61)	(2.33)	(2.21)	(.74)	(-1.45)	(-.09)	
Stationary expansion	A	4.500	.126	-.777	-.009	.276	.171	.336	.616	.723			279
		(2.23)	(.69)	(-1.87)	(-.03)	(1.49)	(.64)	(.96)	(1.59)	(1.55)			
	B	5.992	.134	-.463	-2.103	.277	.219	.789	.981	.733	-3.452	-.292	279
		(2.65)	(.68)	(-1.04)	(-.07)	(1.50)	(.81)	(1.76)	(2.29)	(1.44)	(-2.16)	(-.17)	
Start 1/	A	-1.956	.296	.016	.787	-1.607	.420	-.789	-1.097	-.231			16
	B	-3.614	.176	.037	.953	-1.622	.430	-.724	-1.245	.093	1.657	3.982	16

Note: Asymptotic t-ratios in parentheses.

1/ t-ratios were not computed since establishment starts were used as the normalizing vector.
2/ Log likelihood -1310.51 for Specification A and -1303.85 for Specification B.

Table 5--Multinomial logit estimates and asymptotic t-ratios for the consumer electronics industry (SIC 3651)

Dependent variable	Specification 2/	Coefficient of											Number of observations
		Constant a	Prod. scale b_1	Wage rate b_2	Opp. cost b_3	Owner b_4	Size b_5	North-east b_6	North Central b_7	West b_8	Const. cost b_9	Tax burden b_{10}	
Closure	A	-0.408	-0.152	0.256	-0.466	-0.299	0.588	0.045	0.507	-0.010			244
		(-.21)	(-.88)	(.63)	(-1.71)	(-1.62)	(2.59)	(.13)	(1.35)	(-.02)			
	B	-2.708	-.273	.088	-.446	-.327	.549	-.333	.222	.047	3.632	1.854	244
		(-1.22)	(-1.40)	(.21)	(-1.61)	(-1.75)	(2.39)	(-.73)	(.56)	(.09)	(2.32)	(1.17)	
Relocation	A	-4.811	-.129	.682	-.254	.289	-.493	.074	-.909	-.842			17
		(-.91)	(-.28)	(.63)	(-.38)	(.59)	(-.92)	(.08)	(-.83)	(-.67)			
	B	-1.952	.275	.630	-.351	.383	-.470	-.081	-.779	-1.535	-3.131	-6.413	17
		(-.34)	(.49)	(.57)	(-.52)	(.76)	(-.86)	(-.07)	(-.69)	(-1.10)	(-.81)	(-1.49)	
Stationary contraction	A	1.557	.417	-.429	1.008	.404	-.960	.076	.174	-.530			116
		(.67)	(1.94)	(-.90)	(3.65)	(1.69)	(-3.84)	(.18)	(.39)	(-.94)			
	B	-.904	.314	-.602	1.047	.350	-.974	-.374	-.117	-.518	3.891	1.391	116
		(-.34)	(1.32)	(-1.25)	(3.69)	(1.46)	(-3.88)	(-.67)	(-.25)	(-.81)	(2.00)	(.72)	
Stationary expansion	A	.984	.037	-.218	-.172	-.104	.310	.050	.257	.559			102
		(.41)	(.18)	(-.44)	(-.52)	(-.45)	(1.09)	(.11)	(.57)	(1.00)			
	B	1.211	-.079	-.084	-.137	-.120	.312	.498	.382	.949	-.988	2.593	102
		(.46)	(-.35)	(-.16)	(-.42)	(-.52)	(1.09)	(.88)	(.79)	(1.53)	(-.49)	(1.34)	
Start 1/	A	2.677	-.173	-.291	-.115	-.290	.555	-.245	-.029	.824			303
	B	4.353	-.237	-.014	-.112	-.286	.584	.289	.292	1.056	-3.404	.575	303

Note: Asymptotic t-ratios in parentheses.

1/ t-ratios were not computed since establishment starts were used as the normalizing vector.
2/ Log likelihood -1010.90 for Specification A and -999.96 for Specification B.

Table 6--Multinomial logit estimates and asymptotic t-ratios for the consumer electronics systems and equipment industry (SIC 3662)

Dependent variable	Specification 2/	Coefficient of: Constant a	Prod. scale b_1	Wage rate b_2	Opp. cost b_3	Owner b_4	Size b_5	North-east b_6	North Central b_7	West b_8	Const. cost b_9	Tax burden b_{10}	Number of observations
Closure	A	0.824	0.054	0.023	-0.028	-0.371	0.399	-0.266	-0.136	-0.004			864
		(.77)	(.64)	(.11)	(-.23)	(-3.52)	(3.17)	(-1.44)	(-.67)	(-.02)			
	B	1.054	.097	-.057	-.049	-.370	.402	-.363	-.175	-.086	0.210	-0.847	864
		(.87)	(1.06)	(-.25)	(-.38)	(-3.53)	(3.19)	(-1.55)	(-.78)	(-.33)	(.25)	(-1.05)	
Relocation	A	-8.306	-.190	.011	-.288	.715	-.261	.544	.145	-.498			56
		(-2.68)	(-.79)	(1.85)	(-.80)	(2.35)	(-.79)	(1.02)	(.23)	(-.70)			
	B	-10.063	-.159	.849	-.303	.722	-.263	-.160	-.239	-.868	3.538	-1.754	56
		(-2.83)	(-.61)	(1.32)	(-.82)	(2.38)	(-.79)	(-.24)	(-.37)	(-1.14)	(1.71)	(-.73)	
Stationary contraction	A	4.755	.320	-.878	.203	.105	-.866	.523	.247	.296			385
		(3.67)	(2.93)	(-3.37)	(1.37)	(.80)	(-6.23)	(2.27)	(1.01)	(.95)			
	B	5.489	.323	-.806	.202	.103	-.863	.732	.381	.389	-1.232	.161	385
		(3.80)	(2.79)	(-2.90)	(1.35)	(.79)	(-6.21)	(2.62)	(1.44)	(1.20)	(-1.24)	(.17)	
Stationary expansion	A	1.705	.013	-.309	.066	.027	.069	-.206	-.007	.055			358
		(1.34)	(.13)	(-1.21)	(.44)	(.21)	(.44)	(-.93)	(-.03)	(.18)			
	B	2.086	-.013	-.211	.081	.025	.068	.029	.108	.199	-.989	.896	358
		(1.44)	(-.12)	(-.77)	(.54)	(.19)	(.44)	(.11)	(.41)	(.64)	(-.94)	(.96)	
Start 1/	A	1.022	-.198	.038	.047	-.477	.659	-.595	-.248	.152			1,020
	B	1.434	-.248	.225	.069	-.480	.656	-.238	-.075	.367	-1.527	1.543	1,020

Note: Asymptotic t-ratios in parentheses.

1/ t-ratios were not computed since establishment starts were used as the normalizing vector.
2/ Log likelihood -3547.37 for Specification A and -3538.73 for Specification B.

Table 7--Multinomial logit estimates and asymptotic t-ratios for the consumer electronic components industry (SIC 3679)

Dependent variable	Specification 2/	Coefficient of: Constant a	Prod. scale b_1	Wage rate b_2	Opp. cost b_3	Owner b_4	Size b_5	North-east b_6	North Central b_7	West b_8	Const. cost b_9	Tax burden b_{10}	Number of observations
Closure	A	1.103	0.055	0.001	-0.150	-0.147	0.265	-0.359	-0.567	-0.055			1,237
		(1.36)	(.76)	(.00)	(-1.56)	(-1.75)	(2.50)	(-2.31)	(-3.56)	(-.26)			
	B	.870	.049	-.020	-.145	-.148	.263	-.363	-.601	-.022	0.380	0.492	1,237
		(.98)	(.65)	(-.11)	(-1.50)	(-1.76)	(2.48)	(-2.00)	(-3.43)	(-.10)	(.55)	(.89)	
Relocation	A	-4.242	-.371	.326	-.018	.177	.095	.865	.909	-.425			77
		(-1.93)	(-1.81)	(.74)	(-.07)	(.76)	(.34)	(1.91)	(2.02)	(-.66)			
	B	-5.490	-.394	.001	-.001	.159	.076	.527	.577	-.480	3.290	.480	77
		(-2.24)	(-1.83)	(.00)	(-.01)	(.68)	(.27)	(1.03)	(1.19)	(-.72)	(1.87)	(.32)	
Stationary contraction	A	1.454	.313	-.184	-.069	.342	-1.077	.288	.140	.019			687
		(1.50)	(3.64)	(-.94)	(-.60)	(3.40)	(-10.01)	(1.52)	(.73)	(.08)			
	B	2.085	.367	-.095	-.089	.350	-1.069	.292	.236	-.113	-1.238	-1.509	687
		(2.00)	(4.07)	(-.44)	(-.76)	(3.46)	(-9.91)	(1.33)	(1.12)	(-.42)	(-1.50)	(-2.31)	
Stationary expansion	A	1.915	.253	-.409	.112	.048	.260	-.028	-.001	.213			688
		(2.07)	(3.08)	(-2.17)	(1.04)	(.49)	(2.11)	(-.15)	(-.01)	(.88)			
	B	2.402	.257	-.314	.108	.052	.268	.088	.113	.238	-1.100	-.223	688
		(2.40)	(3.01)	(-1.52)	(1.00)	(.54)	(2.17)	(.42)	(.57)	(.94)	(-1.35)	(-.36)	
	A	-.231	-.251	.266	.124	-.420	.456	-.767	-.481	.248			1,309
Start 1/	B	.134	-.279	.427	.126	-.413	.462	-.544	-.324	.377	-1.333	.761	1,309

Note: Asymptotic t-ratios in parentheses.

1/ t-ratios were not computed since establishment starts were used as the normalizing vector.
2/ Log likelihood -5418.95 for Specification A and -5410.20 for Specification B.

are excluded. Specification B (equation 20) illustrates what happens to estimated coefficients when the tax variable and construction costs are included. The results of these calibrations are discussed below and for discussion purposes summarized in table 8 for Specification A and in table 9 for Specification B.

Production Scale Effects

Hypothesized Relationships

We hypothesize a positive relation between the industry's scale of operations in the area and expected profits due to firm locational decisions. A high level of output for the industry in the area should be associated with increased expected profits and thus increase the likelihood of establishment starts and expanded operations in high production areas and diminish the incentives for relocations from such areas. In terms of establishment closures and contractions in capacity, production scale effects should depend upon the growth performance of the industry and the competitive conditions prevailing in the industry.

All of the selected electrical machinery industries have experienced substantial growth in demand between 1963 and 1969 and wide fluctuations in demand over the business cycle in the 1969-75 period [30]. 33/ When we used value added created in an industry as a measure of the national demand for the output of the industry, it became apparent that between 1963 and 1969 demand increases, in real terms, ranged from 32.6 percent for SIC 3662 to 79.8 percent for SIC 3679 (table 10). The situation was quite different, however, in the 1969-75 period. Demand decreased in all the industries during 1970, 1974, and 1975 and also in 1971 for SIC 3662 and SIC 3679. 34/ The net result was that national demand increased only minimally in SIC 3613 (1.4 percent) and decreased in SIC 3662 (-10.4 percent), SIC 3642 (-10.7 percent), SIC 3679 (-20.5 percent), and SIC 3651 (-28.8 percent) during the study period.

Given the pervasive decline in demand for the output of most of these industries, we would expect strong statistical relationships between the industry's scale of operations in an

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33/ The instability in demand for the output of these industries can be attributed to their reliance upon major economic sectors which were severely affected by the 1974-75 recession, e.g., SIC 3613's dependence upon utility construction; SIC 3642's dependence on construction activity; SIC 3651's reliance on consumer discretionary income (which fluctuates wildly over the business cycle); and, SIC 3662's and SIC 3679's reliance both on government and consumer spending.

34/ During a period of major declines in the demand for the output of an industry, inventory accumulations should be minimal after a few years and value added created should reflect the total demand for the output of the industry at the national level.

Table 8--Multinomial logit relationships, specification A: A summary for the electrical machinery industry 2/

Dependent variable	SIC code	Constant a	Prod. scale b_1	Wage rate b_2	Opp. cost b_3	Owner 3/ b_4	Size 4/ b_5	North-east b_6	North Central b_7	West b_8
		Sign and statistical significance of--								
Closure	3613	-	-	+	+	-	+ ***	+	+	+
	3642	+	-	+	+	+ *	+	-	+	-
	3651	-	-	+	-	-	+ ***	+	+	+
	3662	+	+	+	-	- ***	+ ***	-	-	-
	3679	+	+	+	-	- *	+ **	- **	- ***	-
Relocation	3613	-	-	+	-	-	-	-	-	-
	3642	- *	- zz	+ zz	-	+	+	+	-	-
	3651	-	-	+	-	+	-	+	-	-
	3662	- ***	-	+ zz	-	+ **	-	+	+	-
	3679	- *	- zz	+	-	+	+	+ *	+ **	-
Stationary contraction	3613	+	+	-	+	+ *	- ***	+	+	-
	3642	+ **	+ zz	-	+ zz	+ ***	- ***	+ **	+ *	+
	3651	+	+ z	-	+ zzz	+ *	- ***	+	+	-
	3662	+ ***	+ zzz	-	+ z	+	- ***	+ **	+	+
	3679	+	+ zzz	-	-	+ ***	- ***	+	+	+
Stationary expansion	3613	+ *	+ zz	- zz	+	+ ***	- *	+	+ *	+
	3642	+ **	+	- zz	-	+	+	+	+	+
	3651	+	+	-	-	-	+	+	+	+
	3662	+	+	-	+	+	+	-	-	+
	3679	+ **	+ zzz	- zz	+	+	+ **	-	-	+
Start 1/	3613	+	+	-	+	-	+	-	-	+
	3642	-	+	+	+	-	+	-	-	-
	3651	+	-	-	-	-	+	-	-	+
	3662	+	-	+	+	-	+	-	-	+
	3679	-	-	+	+	-	+	-	-	+

1/ t-ratios were not computed since establishment starts were used as the normalizing vector.
2/ Statistical significance of estimated coefficients is indicated by *'s (*** = 1-percent, level; ** = 5-percent level; and, * = 10-percent level) for a two-tail t-test and by z's (zzz = 1-percent level; zz = 5-percent level; and, z = 10-percent level) for a one-tail t-test.
3/ Owner is a dummy variable taking the value 1 if the establishment is a single-unit operation, 0 otherwise.
4/ Size is a dummy variable taking the value 1 if the establishment has less than 100 employees, 0 otherwise.

Table 9--Multinomial logit relationships, specification B: A summary for the electrical machinery industry 2/

Dependent variable	SIC code	Constant a	Prod. scale b_1	Wage rate b_2	Opp. cost b_3	Owner 3/ b_4	Size 4/ b_5	North-east b_6	North Central b_7	West b_8	Const. costs b_9	Tax burden b_{10}
		Sign and statistical significance of										
Closure	3613	-	-	+	+	-	+ ***	+	+	+	-	+
	3642	+	-	+	+	+ *	+	-	+	-	-	+
	3651	-	- z	+	-	- *	+ **	-	+	+	+ zz	+
	3662	+	+	-	-	- ***	+ ***	-	-	-	+	-
	3679	+	+	-	-	- *	+ **	- **	- ***	-	+	+
Relocation	3613	-	-	+	-	-	-	-	-	-	+	-
	3642	- *	- z	+	-	+	-	-	-	-	+ z	-
	3651	-	+	+	-	+	-	-	-	-	-	-
	3662	- ***	-	+ z	-	+ **	-	-	-	-	+ zz	-
	3679	- **	- zz	+	-	+	+	+	+	-	+ zz	+
Stationary contraction	3613	+	+	-	+	+ *	- ***	-	-	-	+	-
	3642	+ **	+ zz	-	+ zz	+ ***	- ***	+ **	+ **	+	-	-
	3651	-	+ z	-	+ zzz	+	- ***	-	-	-	+ zz	+
	3662	+ ***	+ zzz	-	+ z	+	- ***	+ ***	+	+	-	+
	3679	+ **	+ zzz	-	-	+ ***	- ***	+	+	-	-	-
Stationary expansion	3613	+	+ z	- z	+	+ ***	- *	+	+	+	-	+
	3642	+ ***	+	-	-	+	+	+ *	+ **	+	- zz	-
	3651	+	-	-	-	-	+	+	+	+	-	+
	3662	+	-	-	+	+	+	+	+	+	-	+
	3679	+ **	+ zzz	- z	+	+	+ **	+	+	+	- z	-
Start 1/	3613	+	-	-	+	-	+	-	-	+	+	+
	3642	-	+	+	+	-	+	-	-	+	+	+
	3651	+	-	-	-	-	+	+	+	+	-	+
	3662	+	-	+	+	-	+	-	-	+	-	+
	3679	+	-	+	+	-	+	-	-	+	-	+

1/ t-ratios were not computed since establishment starts were used as the normalizing vector.

2/ Statistical significance of estimated coefficients is indicated by *'s (*** = 1-percent level; ** = 5-percent level; and, * = 10-percent level) for a two-tail t-test and by z's (zzz = 1-percent level; zz = 5-percent level; and, z = 10-percent level) for a one-tail t-test.

3/ Owner is a dummy variable taking the value 1 if the establishment is a single-unit operation, 0 otherwise.

4/ Size is a dummy variable taking the value 1 if the establishment has less than 100 employees, 0 otherwise.

Table 10--Demand trends in the electrical machinery industry, 1963-75 1/

Time period	SIC 3613	SIC 3651	SIC 3642	SIC 3679	SIC 3662
			--Percentage change--		
1963-75	65.4	15.1	45.4	43.0	18.8
1963-69	63.2	61.6	62.9	79.8	32.6
1969-75	1.4	-28.8	-10.7	-20.5	-10.4
1969-72	6.8	6.4	17.3	-10.3	-12.3
1972-75	-5.1	-33.0	-23.9	-11.3	2.2
1969-70	-1.4	-15.1	-1.0	-6.6	-7.4
1970-71	1.6	7.5	2.5	-10.7	-10.5
1971-72	6.6	16.6	15.6	7.5	5.8
1972-73	14.1	20.3	5.3	19.4	9.5
1973-74	-3.2	-26.1	-10.6	-7.0	-4.7
1974-75	-14.1	-24.6	-19.1	-20.1	-2.0

Source: Annual Survey of Manufactures [26].

1/ Value added figures adjusted by the wholesale price index for the products of the electrical machinery industry (1967=100).

area and an establishment's decision to contract operations, especially, in such industries as SIC 3679 and SIC 3651 where demand decreased the most. We would also expect a much weaker relationship between the industry's scale of operations in an area and establishment closures since closures are more likely to occur in all locations during periods of major declines in industry demand.

How firms (establishments) within an industry react to changes in national demand conditions also depends to some extent upon the competitive conditions in the industry. For example, according to Bain [5], we can classify SIC 3642 and SIC 3679 as low-grade oligopolies and SIC 3662 as unconcentrated (table 11). These industries are characterized by a moderately concentrated oligopolistic core with a very large competitive fringe of a very large number of small sellers. We would expect establishments in such competitive industries to expand their capacity to meet rising demand but the extreme competitiveness would make it difficult for these establishments to offset decreases in demand by higher prices. Thus, as national demand falls, we would expect closures and contractions in capacity, especially, in high production areas where numerous establishments had previously located. The other two industries, SIC 3613 and SIC 3651, on

Table 11--Classification of selected electrical machinery industries by Bain's concentration types and industry characteristics, 1972

Industry concentration type 1/	Share of value of shipments: Eight largest companies	Share of value of shipments: Four largest companies	Companies	Establishments	Percentage of multi-unit establishments	Size of average plant (employment)
	----Percent----		---Number---		Percent	Number
I. Very highly concentrated						
None	-	-	-	-	-	-
II. High concentrated						
None	-	-	-	-	-	-
III. High-moderate concentrated						
SIC 3613	65	51	462	698	34	99
SIC 3651	71	49	343	503	27	173
IV. "Low-grade" oligopolies						
SIC 3642	50	37	1,089	1,496	21	49
SIC 3679	47	37	2,181	3,054	27	63
V. Unconcentrated						
SIC 3662	33	19	1,524	2,163	35	148

Source: Census of Manufactures [28].

1/ The types are defined by Bain [5] as: type I has an eight-firm concentration ratio (CR8) of 90-percent or more or a four-firm concentration ratio (CR4) of 75-percent or more; type II has CR8 of 85 to 90-percent or CR4 of 65 to 74-percent; type III has CR8 of 70 to 84-percent or CR4 of 50 to 64-percent; type IV has CR8 of 45 to 69-percent or CR4 of 35 to 49-percent; type V has CR8 of 44-percent or less or CR4 of 34-percent or less.

the other hand can be classified as high-moderate concentrated. The higher degree of top-level concentration in these industries is certain to produce a substantial degree of oligopolistic interdependence among the larger firms. Here, the competitive fringe is smaller and less important than in the two categories described above. We would expect firms in these oligopoly industries to close establishments in low production areas and contract operations in high production areas on the assumption that future demand increases will show up, most likely, in the previously high production locations.

Results

The relationship between the industry's production scale in the area and establishment contractions conforms well to our hypothesis (table 8). Specification A indicates that in every industry, competitive and oligopolistic, the probability of contraction was positively correlated with the industry's scale of operations in the area. That is, the probabilility of establishment contraction increased in high production areas. As expected, the production scale coefficients were always statistically significant for industries which had experienced a decrease in demand between 1969 and 1975. 35/ The results were not statistically significant for the switchgear (SIC 3613) industry, the only industry which experienced an increase in demand over the 1969-75 study period.

In all of the industries, the production scale coefficients were also of the correct sign for establishment relocations and expansions. That is, high local production levels decreased the probability of an establishment relocating and increased the probability of an expansion in plant capacity. These relationships were statistically significant for relocations and expansions in the electronic components (SIC 3679) industry; for relocations in the lighting fixtures (SIC 3642) industry; and for expansions in the switchgear industry.

Results for closures and new starts were somewhat less satisfactory. The production scale coefficients for establishment closures were of the expected sign both in the oligopolistic and in most of the competitive industries. The probability of closure in two of the competitive industries (SIC 3662 and SIC 3679) was positively correlated with location in high production areas

35/ The criterion used for assessing the statistical significance of the estimated coefficients for the demand, wage rate, opportunity cost of capital, tax burden and construction cost variables was the one-tail t-test at the 1-, 5-, and 10-percent levels. The two-tail t-test was used for the ownership, size, and region variables. It is also possible to test the significance of the estimated coefficients by calculating the -2 log likelihood ratios, i.e., by dropping a specific independent variable, re-estimating the value of the likelihood function, and comparing the result with the unrestricted maximum. This value is asymptotically distributed as χ^2 with one-degree of freedom [20]. The latter test was not performed because it involved considerable computation costs.

while in the oligopolistic industries (SIC 3613 and SIC 3651) this correlation was negative for such areas. However, the coefficients were never statistically significant. The production scale coefficient for new starts was of the expected sign only in two industries. That is, the probability of a new start in the SIC 3613 and SIC 3642 industries increased with the level of production in the area. 36/ The lack of positive correlation between the probability of new starts and the level of industry production in the other three industries may be due to rapidly increasing imports and regional diversification of production facilities. For example, in the SIC 3651 and SIC 3679 industries, most of the market growth has been sustained by imports from foreign producers and overseas facilities of American companies. Thus, areas with low levels of industry production, where the competition may be less intense, may be more attractive sites for new establishments. The negative correlation between the probability of new establishment starts in the SIC 3662 industry and local production levels may be due to the long lead time for production, which characterizes this industry. Establishment starts, especially branch operations, may appear only after all the planning, design, and construction work has been completed.

As mentioned above, two industries experienced major declines in demand (over 20 percent) during the 1969-79 period. One industry was the high-moderate concentrated SIC 3651 and the other industry was the low-grade, oligopoly SIC 3679. The results for these two industries stand out in sharp contrast. For the consumer electronics industry (SIC 3651), expected relationships were derived between local production levels and the probability of establishment expansion, contraction, relocation, and closure. However, the production scale coefficient was statistically significant only for establishment contractions. The lack of statistically significant findings for the other location decisions may be due to the lack of competitive behavior by this industry in the face of substantial market penetration by foreign producers. The electronic components (SIC 3679) industry, on the other hand, was characterized by stiff domestic competition during this period rather than import competition. Expected relationships were obtained for this industry also between local production scale and the probability of establishment relocation, expansion, contraction, and closure. However, the local production scale coefficients were statistically significant for three location decisions: establishment expansions, contractions, and relocations. The results

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36/ The multinomial logit model is identified only up to scale and requires normalization. In calibrating the present model, coefficients were normalized by constraining all the coefficients to sum to zero. Since establishment starts were selected as the normalizing vector, coefficients for new starts are thus equal to the negative of the sum of the coeffcents for the other locational processes. As a result, it was not possible to determine statistical significance of the coefficients for new starts.

for this industry, in contrast to the other four industries, conformed the closest to our expectations regarding local production levels and their effect on the various location decisions. It seems that the stiff domestic competitive conditions in this industry have encouraged decisionmakers to conform more closely to behavior suggested by economic theory.

The inclusion of construction costs and tax burden on business as explanatory variables (Specification B) altered the results primarily for the consumer electronics (SIC 3651) industry (table 9). The local production scale coefficient for establishment closures in this industry became statistically significant, indicating that the probability of closures decreased in areas with high levels of production. The only other changes occurred in some of the correlations between production scale and the probability of relocation in SIC 3651; the probability of expansion in SIC 3651 and SIC 3662; and the probability of new starts in SIC 3613. However, the latter results were not statistically significant in either Specification A or B.

Wage Rate Effects

Hypothesized Relationships

We hypothesized a positive relation between local industry wage rates and the probability that firms in the industry will close, contract, or relocate establishments. We expected that favorable local industry wage rates should be conducive to the start of new establishments and the expansion of capacity in stationary establishments.

These relationships should be especially significant in the case of labor-intensive industries. Among the selected electrical machinery industries, switchgear (SIC 3613) and electronic systems (SIC 3662) can be classified as high-wage, labor-intensive industries and electronic components (SIC 3679) as a low-wage, labor-intensive industry (table 12). According to this classification, an industry is labor-intensive if the industry's total payroll per dollar of value added or production wages per dollar of value added exceeded the national level of labor intensity.

Results

Specification A indicates that the wage rate coefficients for establishment relocations, expansions, and closures were of the expected sign both in the labor-intensive and nonlabor-intensive industries. The results indicate that high local industry wage rates are positively correlated with the probability of an establishment relocating from the area or closing operations and negatively correlated with the probability of establishment expansions. The coefficients were statistically significant for relocations in the lighting fixtures (SIC 3642) and electronic systems (SIC 3662) industries and for establishment expansions in the switchgear (SIC 3613), lighting fixtures (SIC 3642), and electronic components (SIC 3679) industries. None of the coefficients, however, were statistically significant for closures. It appears that local wage rates are not important factors for establishment closures in these industries.

The wage rate variable did not perform as expected for establishment starts in most of the industries. The sign of the wage coefficient was incorrect for establishment starts in three of the five industries. 37/ Low wage rates increased the probability of establishment starts only in the switchgear (SIC 3613) and consumer electronics (SIC 3651) industries. The positive correlation between local wage rates and the probability of establishment starts in the other industries may simply reflect the fact that increased birth activity (in this case, in high wage areas) tends to be associated with an increased demise of establishments. 38/

Table 12--Labor characteristics in the electrical machinery industry, 1972

Characteristic	Industry					
	Total manufacturing	SIC 3613	SIC 3679	SIC 3662	SIC 3642	SIC 3651
Labor intensity:			Percent			
Total payroll as a percentage of value added	45	48	53	62	45	36
Production worker payroll as a percentage of value added	30	30	32	25	29	25
Wage rate (production worker payroll per worker hour)			Dollars			
	3.95	4.00	3.12	4.51	3.52	3.43
Size of plant (average employment)			Number			
	42	99	63	148	49	173

Source: Census of Manufactures [28].

37/ The results for establishment starts (single and multi-unit) in SIC 3662 and in SIC 3679 do not conform with Carlton's [9] finding that local (SMSA) wage rates in these industries are negatively correlated with the likelihood of the start of a new single establishment firm. Carlton also analyzed new branch plant starts; however, local wage rates in the latter case were not statistically significant.

38/ See e.g., Miller [17].

The results for plant contractions were contrary to expectations. Wage rates were negatively correlated with the probability of establishment contractions in all the industries. In the lighting fixtures (SIC 3642) and electronic systems (SIC 3662) industries, the wage rate coefficients were statistically significant at the two-tail, t-test but not at the one-tail, t-test. The negative correlations suggest that firms in these industries are more likely to contract operations in low-wage areas and close operations in high-wage areas (as indicated by the positive correlations between wage rates and closures).

The inclusion of construction costs and the tax burden on business as explanatory variables (Specification B) alters the results primarily for the lighting fixtures (SIC 3642) industry. The wage rate coefficients for establishment relocations and expansions in this industry are no longer statistically significant. This suggests that multicollinearity may exist between the wage rate variable and the construction costs or tax burden variables. The only other alterations in results occurred in the SIC 3662 and SIC 3679 industries where the correlation between the local wage rate and the probability of establishment closures became negative. However, these correlations were not statistically significant in either Specification A or B.

Opportunity Cost of Capital Effects

<u>Hypothesized Relationships</u>

We hypothesized a negative relation between the local opportunity cost of capital to the industry and expected profits due to firm locational decisions. If the local opportunity cost of capital for the industry is low in relation to other areas, we would expect births of new establishments and expansions in production (employment) by establishments located in the area rather than establishment closures, contractions, or relocations from the area.

<u>Results</u>

There appears to be support for the hypothesis that the industry's local opportunity cost of capital is positively related to the probability of establishment contractions in operations (employment). Coefficients for the opportunity cost of capital variable were of the correct sign for establishment contractions in all of the industries, except for electronic components (SIC 3679). 39/ The results indicate that high local opportunity costs of capital in the industry (i.e., low local profitability levels in the industry) increased the probability of establishment contractions in the switchgear (SIC 3613), lighting fixtures (SIC 3642), consumer electronics (SIC 3651), and electronic systems (SIC 3662) industries. In the latter three industries the coefficients were also statistically significant.

39/ This result and results for the other location decisions with respect to the opportunity cost of capital did not change between Specifications A and B of the multinomial model.

The opportunity cost of capital variable performed very poorly for the other locational processes (closures, relocations, expansions, and new starts). The coefficients were of the expected sign only for establishment closures in the SIC 3613 and SIC 3642 industries; for expansions in the SIC 3642 and SIC 3651 industries; and for new starts in the SIC 3651 industry. However, these coefficients were not statistically significant at the one-tail, t-test. In the other industries, the opportunity cost of capital was positively correlated both with the probability of establishment expansions and the probability of new starts. The opportunity cost of capital variable always entered negatively for relocations and in three of the five industries (SIC 3651, SIC 3662, and SIC 3679) the coefficients were also negative for closures. The negative correlations between the opportunity cost of capital and the probability of relocations or closures may reflect the competive pressures in high-profit areas which are forcing firms to either close or to relocate their establishments to areas with lower profitability levels for the industry as a whole.

Ownership Effects

Hypothesized Relationships

The ownership effect is represented by a dummy variable taking the value of one if the establishment in the industry is a single-unit operation and zero if the establishment is part of a multi-unit operation (branch or headquarters). It is hypothesized that a firm with multi-unit operations may be better able not only to evaluate potential profits due to locational decisions but also has the financial resources to make adjustments in its output (location) decisions. For example, in periods of declining national demand a multi-unit firm often has the choice of consolidating operations by closing some establishments while maintaining production in other establishments. The single-unit firm does not have this option. Thus, we expect the dummy coefficients for single-unit establishments to be negative in relation to that of establishments in multi-unit operations in terms of closures and positive in terms of establishment contractions. In periods of increasing national demand, all firms, single and multi-unit, have the option to expand their capacity. However, the multi-unit firm may have greater freedom, i.e., more options, to respond more readily to new profit opportunities by establishing new production facilities. We would thus expect the dummy coefficients for single-unit establishments to be positive in terms of establishment expansions and negative in terms of new establishment starts. On the other hand, a single-unit firm may be more likely to consider relocation than would the multi-unit firm. Although the magnitude of decision may be greater to the single-unit firm, e.g., moving an entire business, the relocation decisionmaking process may be much more simple since such a firm does not have to consider the ramifications of its move on the organizational structure of its other establishments. Therefore, a positive sign is tentatively hypothesized for the dummy coefficient in relation to establishment relocations.

Results

The effects of ownership, i.e., the establishment's organizational structure, on the probability of occurrence of specific

locational processes were quite consistent among the various industries and in accordance with our expectations. It was expected that the dummy coefficients for single-unit operations should be negative in relation to that of multi-unit firms in terms of establishment closures and new starts and positive in relation to establishment relocations, contractions, and expansions. The results for both specifications (A and B) of the multinomial model indicate that during the analysis period the probability of relocation, contraction, or expansion increased if the establishment was a single-unit operation. A multi-unit operation, e.g., a branch or headquarters establishment, on the other hand, increased the probability of a closure and also that of a new start. The only exceptions to this pattern were the lighting fixtures (SIC 3642) industry where single-unit operations increased the probability of closure and the switchgear (SIC 3613) and consumer electronics (SIC 3651) industries where being a single-unit operation decreased the chances of relocation and expansion, respectively.

In most industries, the coefficients of the ownership variable were statistically significant for establishment closures and contractions. The only exceptions were for closures in the switchgear (SIC 3613) and consumer electronics (SIC 3651) industries and contractions in the electronic systems (SIC 3662) industry. The ownership effects were also statistically significant for relocations in SIC 3662 and for establishment expansions in SIC 3613. 40/

Except for the consumer electronics (SIC 3651) industry, results did not change between Specifications A and B of the multinomial model. In SIC 3651, the ownership coefficient for closures became statistically significant in Specification B. And, for contractions, the ownership coefficient became statistically insignificant in Specification B.

It appears that the corporate sector in the electrical machinery industry, irrespective of industry characteristics such as competitive conditions or labor-intensity, is more willing, or perhaps able, to start and close operations (such as branches and headquarters) than are the independent entrepreneurs. The latter, on the other hand, are more prone to relocate or to make capacity adjustments such as contractions and expansions in stationary establishments. These results corroborate Barkley's [6] findings that single-unit establishments provide greater employment stability to local areas (at least in Iowa) than corporate firms since the latter are more prone to start and close branch operations during the various phases of the business cycle.

40/ An attempt was made to calibrate the multinomial logit model separately for single-unit establishments and multi-unit establishments. This effort was not successful due to the paucity of observations for some locational processes, such as relocations, and a lack of convergence in other instances.

Size Effects

<u>Hypothesized Relationships</u>

The size effect is represented by a dummy variable taking the value of one if the establishment has less than 100 employees and zero otherwise. We tentatively hypothesized that the dummy coefficients for small establishments should be positive in relation to that of large establishments in terms of closures, starts and, in the case of industries characterized by small plants, for relocations and expansions in operations. We expected a negative relation for small establishments in terms of contractions in capacity (rather than closures) and also for relocations and expansions in industries with large average size establishments.

<u>Results</u>

The results of the multinomial logit analysis for establishment size effects on locational decisions conformed fairly well to hypothesized relationships. The probability of new starts and closures increased, as expected, if the establishment in question was small in size (less than 100 employees). Size coefficients were statistically significant for closures in all industries, except lighting fixtures (SIC 3642). In contrast, the probability of an establishment contracting its operations decreased, also as expected, in all the industries if the establishment was small in size. Size coefficients for contractions were statistically significant in all the industries.

The size coefficients were also of the expected sign for establishment relocations in all industries and for expansions in three of the five industries. In the two industries (SIC 3642 and SIC 3679) with relatively small average size establishments (table 12), the probabilities of relocation and expansion seemed to increase if the establishment was small in size. In the three industries (SIC 3613, SIC 3651, and SIC 3662) with large average size establishments, the probability of relocation seemed to increase only if the establishment was large. 41/ However, all of the size coefficients for relocations and, except for SIC 3613 and SIC 3679, for establishment expansions were statistically insignificant. In SIC 3613 and SIC 3679 the size coefficients were statistically significant indicating that large establishments were more likely to expand operations in the former industry and less likely to expand operations in the latter industry.

The association between size of plant and probability of a locational change occurring conform reasonably well to our expectation that small plants are more volatile in terms of locational decisions. There tends to be substantial locational activity in terms of establishment starts and closures. 42/ Many small

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41/ In Specification B of the multinomial model, the probability of relocation in SIC 3642 decreased if the establishment was small in size. However, this relationship was not statistically significant. Other results did not change between the two specifications (A and B).

42/ See e.g., Miller [17].

operations are started and many are closed. This seems to be reflected by the positive size coefficients for establishment closures, expansions, and new starts and by the negative size coefficients for establishment contractions. That is, small size increased not only the probability of a new start or of an expansion in operations but also that of a plant's demise. The large establishment, on the other hand, appears to be better able to make downward output adjustments (contract) without going out of business. Overall, these relationships appear to be especially significant statistically for closures and stationary firm contractions.

Regional Effects

Hypothesized Relationships

The regional dummies are represented by three binary variables equal to one if the establishment was located in the Northeast, Northcentral, or Western regions of the Nation, respectively, and zero otherwise. The fourth region of the country, the South, was chosen as the omitted category since it appears to differ from the rest of the country. This was the only region which experienced employment increases in the SIC 36 group during 1967-72. We expected the coefficient of the Northeast regional dummy variable to be positive with respect to establishment closures, relocations, and contractions and negative with respect to establishment expansions and new starts since this is a declining region in terms of manufacturing. This is also probably true for the North Central region. In an expanding economy such as the West, we expected the coefficient for this dummy variable to be positive for new establishment starts and also for expansions in the operation of stationary establishments.

Results

The signs of the region variables for the different locational processes were consistent, as a rule. The results suggest that relative to the South the probability of a new start decreased if the establishment was located in the Northeast or North Central regions and increased if it was located in the West. In contrast, the probability of expansion and that of contraction increased not only for most industries in the West but also increased for a majority in the Northeast and North Central regions. The signs were less consistent for establishment closures and relocations. Nevertheless, for a majority of the industries, the probability of closure and that of relocation decreased if the establishment was located in the West. The probability of closure and that of relocation also decreased in the Northeast and North Central regions, respectively.

Statistically significant coefficients occurred only for the Northeast and North Central region variables. However, the same variables were not statistically significant for all the different industries or locational processes. For example, the Northeast variable was statistically significant for establishment contractions both in the lighting fixtures (SIC 3642) and electronic systems (SIC 3662) industries but for establishment closures only in the electronic components (SIC 3679) industry. This variable happened to be also statistically significant

for relocations in the SIC 3679 industry (Specification A, only) and for establishment expansions in the SIC 3642 industry (Specification B, only). Similarly, the Northcentral variable was statistically significant for establishment closures in SIC 3679 and for contractions in SIC 3642. This variable was also statistically significant for establishment relocations in SIC 3679 and for expansions in SIC 3613 (Specification A, only) and SIC 3642 (Specification B, only). Given the heterogenous nature of the industries selected for analysis, such results were not surprising.

Construction Cost Effects

Hypothesized Relationships

We hypothesized a negative relation between local construction costs and the probability that firms in an industry will expand operations or start new establishments. We also expected that adverse construction costs will encourage firms to relocate their facilities to more favorable areas. A tentative hypothesis is that establishment closures and contractions are positively correlated with local construction costs, especially, if the facilities are becoming obsolete or are fully or nearly depreciated.

Results

Specification B of the multinomial logit model (table 9) provides support for the hypothesis that local construction costs are negatively related to the probability of establishment expansions and that of new starts and positively related to the probability of establishment relocations. Coefficients for the construction cost variable were of the correct sign for establishment expansions in all industries and for relocations and new starts in most industries. The only exceptions occurred for relocations in the consumer electronics (SIC 3651) industry and for new starts in the switchgear (SIC 3613) and lighting fixtures (SIC 3642) industries. In terms of statistically significant findings, the results indicate that the probability of establishment expansions in the lighting fixtures (SIC 3642) and electronic components (SIC 3679) industries increased in areas with low construction costs while high construction costs increased the probability of relocation in these industries and also in the electronic systems (SIC 3662) industry.

As expected, there appears to be less support for the hypothesis that establishment closures and contractions depend upon local area construction costs. Although construction costs were positively correlated with the probability of establishment closures in such industries as SIC 3651, SIC 3662, and SIC 3679 and the probability of establishment contractions in SIC 3613 and SIC 3651, statistically significant results occurred only in the consumer electronics (SIC 3651) industry. The findings for closures and contraction in the consumer electronics industry may reflect the continuing trend in this industry of relocating facilities overseas. 43/ Continuing import penetration of the

43/ For a review of developments in the electrical machinery industry, see e.g., U.S. Industrial Outlook [30].

U.S. market by foreign producers has forced domestic producers in this industry to establish facilities in foreign countries. Likely prospects for such relocations are facilities which have become obsolete or are fully or nearly depreciated. However, relocations to foreign countries are treated as closures in the present (D&B) data files. The treatment of such relocations as closures may have weakened the statistical relationship between construction costs in an area and the decision to relocate establishments and, at the same time, strengthened the relationship between construction costs and closures in this industry.

Business Tax Effects

Hypothesized Relationships

We hypothesized a positive relation between business taxes in a State and the probability that firms will contract plant capacity or close and relocate establishments. We also expected that favorable business taxes within the State will be conducive to the start of new establishments and the expansion of capacity in stationary establishments.

Results

There is little empirical support for the proposition that State and local taxes with an initial impact on busines influence firm location decisions. Results for Specification B (table 9) indicate that this tax variable did not perform well. The coefficients for the tax variable are statistically insignificant and in most cases of the incorrect sign. The only consistent finding was that there seems to exist a positive correlation between tax burden on business and the probability of establishment closures in four of the five industries. The only exception was the electronic systems (SIC 3662) industry. Other expected correlations occurred for relocations in the electronic components (SIC 3679) industry; for contractions in the consumer electronics (SIC 3651) and electronic systems (SIC 3662) industries; and for expansions in the lighting fixtures (SIC 3642) and electronic components (SIC 3679) industries. These results are only suggestive since the correlations were not statistically significant at the one-tail, t-test.

The failure to empirically verify the hypotheses that business taxes are important in firm location decisions is consistent with results of previous studies. For example, Schmenner [23] and Moses and Williamson [18] found that property taxes do not exert statistically significant effects on intrametropolitan business location decisions. Carlton [9], in his intermetropolitan study of firm location decisions, also concluded that there is no empirical support for the hypothesis that State personal and corporate taxes are a major factor in deterring new business activity.

There are several possible explanations why taxes have little or no effect on firm location decisions. One possible explanation is that State-local taxes form only a small part of total cost for a firm and, in addition, are deductable from Federal taxes which do not vary across areas. A second explanation is that State-local taxes are used to purchase services for the firm. When high taxes mean good public services, as they often do, the

firm will not have to supply the services, such as sewage disposal, police and fire protection, streets. Thus, if benefits derived from such taxes cancel costs, taxes will have little effect on locational activity. A third possible explanation is that taxes may be shifted forward on the consumers for the products of the firm or backwards on the factors of production.

Summary of Findings

The multinomial logit analysis indicates that size and ownership structure were important determinants of firm location decisions in most of the industries selected for analysis. The results show that the probability of a closure or of a new start increased if the establishment was a small, multi-unit operation, e.g., a branch or headquarters. On the other hand, the probability of a contraction increased if the establishment was a large, single-unit operation. The probability of relocation or of an expansion in operations was also positively associated with large and small, single-unit operations, respectively. However, the latter associations were statistically significant only for a few industries.

There was limited confirmation of the hypothesis that favorable national demand conditions may increase profit expectations in the industry and thus increase the likelihood of plant expansions and the start of new establishments and deter establishment relocations in high production locations. The results indicate that for some industries high local production levels did decrease the probability of establishment relocation and increase the probability of a new start or an expansion in plant capacity. The relationship between local production levels and establishment contractions also appeared to conform to our expectations. In every industry, the probability of establishment contraction increased in areas with high levels of industry output. The latter result may be due to large fluctuations in national demand for the output of these industries during the 1969-75 period. During recessionary periods, we would expect both the oligopolistic and competitive industries to adjust their capacity downward in areas with previously high production levels. Results for closures were less satisfactory. Although the results seem to indicate that high production levels in an area decrease the probability of establishment closures in oligopolistic industries while increasing such probability for competitive industries, the production scale coefficient for closures in the more competitive industries was never statistically significant.

There was partial support for the hypothesis that local industry wage rates affect firm locational decisions, especially in the labor-intensive industries. High local industry wage rates increased the probability of an establishment relocating from the area while low local wage rates were conducive to establishment expansions and, in some industries, to the start of a new operation. The negative correlations for establishment contractions may indicate that entrepreneurs in these industries were more prone to make downward adjustments in capacity in low-wage areas rather than close operations and lose, perhaps, a trained

labor force. The results also indicate that local wage rates were not an important factor in the demise of establishments.

There was also support for the hypothesis that local construction costs affect firm locational decisions, particularly the decisions to start, expand, and relocate operations. The results indicate that favorable local construction costs were associated with an increased probability of plant expansions in all of the industries and that of new starts in most industries. As expected, high construction costs increased the probability of establishment relocations. The relationship between local construction costs and the probability of establishment closures and contractions was more tenuous. Although construction costs were positively correlated with the probability of establishment closures in three industries and that of contractions in two industries, statistically significant results occurred only in the consumer electronics (SIC 3651) industry.

It was hypothesized that the industry's local opportunity cost of capital is negatively related to expected profits due to firm locational decisions. If the industry faced an elastic demand curve, a decrease in the local opportunity cost of capital should have served as an incentive both for new establishment starts and for expansions in stationary establishments rather than relocations, closures, or contractions in operations. Overall, the hypothesis was supported only for establishment contractions. The results indicate that high local opportunity cost of capital for the industry increased the probability of establishment contractions. For the other locational processes, the local opportunity cost of capital for the industry was either unimportant or performed contrary to expectations.

There is little support for the proposition that State-local business taxes affect firm location decisions. Although the probability of plant closures in four industries was positively correlated with the change in the State-local tax burden on business, as was the probability of relocations in one industry and that of contractions in two industries, these relationships were never statistically significant. Similarly, the negative correlation between business taxes and the probability of expansions (in two industries) was also statistically nonsignificant.

Discrete region variables were used to determine if the other independent variables accounted for all of the differential in firm behavior between the South and such regions as the Northeast, North Central and West. Although there was an association between regional location and specific locational decisions in some industries, the regional effects, generally, were not statistically significant.

RESEARCH IMPLICATIONS

During the past several decades, a considerable effort has been made by Federal, State, and local governments to create employment opportunities in various cities and communities. These efforts have ranged from local investments in infrastructure to local tax concessions and to various public assistance programs of such agencies as the Economic Development Administration, Farmers Home Administration, and the Title V regional commissions. The basic premise underlying these efforts has been that industrial development can be promoted or facilitated by either changing interarea cost advantages or ameliorating market imperfections. 44/ The overall results of these efforts have been mixed. Some communities, for example, have attracted new establishments by providing industrial parks, access to transportation facilities, and other improvements in the local infrastructure. Other communities, with similar improvements, have had little or no success. Also, in some instances, where direct financial subsidies were provided to particular firms, it is not clear whether these recipients would not have started or expanded operations even without such financial assistance.

A major difficulty in analyzing and formulating policy for industrial development of specific geographic areas has been the lack of adequate information on the determinants of firm location decisions. It is generally agreed that location decisionmaking is a very complex process for most firms. Unfortunately, most industrial location studies have had to rely on survey data, which are frequently cross-sectional, or net change measures from national censuses of economic activity. The use of aggregate net change measures not only does not provide any indication of which is the dominant locational process but gives little insight into actual firm behavior and the determinants of firm behavior. This makes comparisons difficult and presents problems for generalizing conclusions about firm decisions regarding relocations, new starts, closures, expansions, and contractions. Moreover, consensus disappears in regard to which industry attributes and, especially, what specific local area characteristics are important in explaining such decisionmaking.

There is a need to improve the current state of knowledge about industrial decisionmaking. Effective public policy at the Federal, State, and local levels for influencing industrial location depends upon research results on how economic variables and/or firm attributes affect locational decisions. For example, are firm location decisions really economic decisions? If so, what are the characteristics of places where firms are likely to

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44/ From a national perspective and from an efficiency criterion it may not make much sense to prevent firms from leaving an area because of increased labor or fuel costs or other economic considerations. One may assume that labor will adjust to any new industrial location pattern. However, from a local perspective a relocation or plant closure can have disastrous shortrun consequences for the local residents who had depended upon such enterprises.

locate or remain and prosper? Are there distinguishing features that characterize those firms which close or relocate their operations? Do plant closings represent random events which the community can neither prevent or insure against? If not, can the probability of such occurrence be altered through planned community action? Answers, or at least insights, to these question could be invaluable in formulating public policy strategies for encouraging the development or revitalization of economically depressed areas, such as rural areas and the core areas of the central cities.

The results of the present study indicate that establishment size and ownership structure are important determinants of firm locational decisions. The probability of a closure or of a new start increases if the establishment is a small, multi-unit operation, e.g., a branch or headquarters. On the other hand, the large single-unit establishment increases the probability of a contraction in operations. These findings may have important policy implications. Since multi-unit operations of firms are more locationaly unstable than single-unit establishments, communities with a heavy concentration of small branch plants are likely to experience problems in maintaining or expanding their economic base. For example, some communities do benefit during the expansionary phase of the business cycle as multi-unit firms expand their operations by establishing new branch plants. But, the gains may be of short duration. As the economy turns down, multi-unit firms are likely to adjust their operations (capacity) by closing some of their newly established, or even older, branches. Large, single-unit firms, on the other hand, are more apt to contract their output during periods of depressed demand rather than close their entire operation. Thus, if a community is confronted with the choice of using its limited resources (such as industrial revenue bonds, tax concessions, improved sites, or facilities) either to assist residential businesses or to attract branch operations to the area, greater long-term benefits may be reaped by the community in terms of employment stability by fostering (assisting) locally owned or home grown businesses. 45/

This study also shows that certain economic factors do influence firm location decisions in some industries. Business taxes, on the other hand, do not appear to be an important factor in firm locational activity. There is an indication that high levels of industry operations, low wage rates, and low construction costs in the community decrease the probability of relocation and increase the probability of new establishment starts and also that of expansions in existing establishments. Establishments located

45/ Especially since relocations represent only a minor fraction of the total locational change, e.g., only 2.2 percent of the establishments in the five electrical machinery industries relocated across county lines during the study period (table 2).

in areas where the opportunity cost of capital is high are more prone to contract their operations. Contrary to expectations, local wage rates, production scale, and the opportunity cost of capital do not appear as important factors for establishment closures, at least in the electrical machinery industry. In the case of multi-unit operations, management's decision to close particular branch establishments may be more a function of national economic conditions rather than local factors. Furthermore, the demise of single-unit establishments may represent the final act of a long, drawnout process of deteriorating profits where marginal improvements in current local conditions cannot reverse the process. 46/

The possibility that economic factors are important in firm location decisions suggests that policymakers concerned with area development efforts can and should concentrate on improving different factors if such efforts result in ameliorating market imperfections. That is, if markets can be made more competitive, society as a whole would benefit from a more efficient allocation of productive capacity.

The economic factors considered in this study--production scale, wage rates, construction costs, and opportunity cost of capital --are, to some extent, amenable to manipulation through public action programs. Respective examples are export promotion, right to work laws, investments in local infrastructure and expansion in credit availability. Various public policies in reference to tax credits, tax exemptions, subsidized loans, and the provision of facilities or services can affect both the relative cost or availability of different factors and the price and availability of a given factor of production in different locations. Such policy tools can be used either selectively to influence the distribution of industrial activity and promote growth in selected communities, or broadly to influence the overall level of growth in the industry. Benefits would accrue to society if such policies, e.g., filled a "credit gap" or reduced unemployment in labor surplus areas with no loss of productivity nationwide. However, there exists the distinct possibility that various incentives offered by State and local governments to attract or promote businesses may, at best, have little effect and, at worst, may represent a serious misallocation of resources. There is the possibility that State incentive programs have merely served to reshuffle a relatively fixed number of manufacturing establishments and that the different levels of government are merely subsidizing firms for performing activities they would

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46/ The lack of statistically significant findings for some of the locational processes may also be due to the possibility that these slowly declining electrical machinery industries have reached a stage of longrun equilibrium where actual rates of return are equal in all areas. In that case, firms would be indifferent among alternative destinations and explanatory power of measured returns, wages, and other site characteristics would be small.

have undertaken in any case. Also, it is not always certain that firms will locate in a community in response to that community's investment in infrastructure. Often, the investment or subsidy is simply too small. Furthermore, job expansion through various government subsidies to firms may occur largely in declining industries, i.e., activities which are not capable of self-sustaining growth. All of these possibilities may represent potential misallocations of resources at the national level.

The finding in this study that State-local business taxes are not an important factor in firm locational activity, at least in the electrical machinery industry, suggests that State financial economic development activities in a particular State may simply be offsetting similar activities in other States with a resulting waste of scarce public funds.

Models of industrial location decision are necessary to properly assess local and regional impacts of public policies. And, qualitative choice models appear to provide a suitable framework for shedding some light on the potential effects of public action programs on firm location decisions. That is, changes in community conditions can be evaluated in terms of firm locational probabilities.

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APPENDIX A

GEOGRAPHIC AREAS INCLUDED IN THIS RESEARCH

Region, State, SMSA	Constituent counties
New England	
Connecticut	All counties
Massachusetts	
Boston SMSA	Essex, Middlesex, Norfolk, Plymouth, Suffolk
Springfield SMSA	Hampden, Hampshire
State residual	All other counties in Massachusetts
New Hampshire	All counties
Middle Atlantic	
New Jersey	
Jersey City SMSA	Hudson
Newark SMSA	Essex, Morris, Somerset, Union
Patterson SMSA	Bergen, Passaic
State residual	All other counties in New Jersey 1/
New York	
Buffalo SMSA	Erie, Niagara
New York City SMSA	Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester
Rochester SMSA	Livingston, Monroe, Ontario, Orleans, Wayne
State residual	All other counties in New York
Pennsylvania	
Allentown SMSA	Carbon, Lehigh, Northampton, Warren (N.J.)
Lancaster SMSA	Lancaster
Philadelphia SMSA	Bucks, Chester, Delaware, Montgomery, Philadelphia, Burlington (N.J.), Camden (N.J.), Gloucester (N.J.)

1/ Except for Burlington, Camden, Gloucester and Warren counties which are included in selected Pennsylvania SMSA's.

Region, State, SMSA	Constituent counties
Pittsburgh SMSA	Allegheny, Beaver, Washington, Westmoreland
Reading SMSA	Berks
State residual	All other counties in Pennsylvania
East North Central	
Illinois	
Chicago SMSA	Cook, Du Page, Kane, Lake, McHenry, Will
State residual	All other counties in Illinois 2/
Indiana	
Indianapolis SMSA	Boone, Hamilton, Hancock, Hendricks, Johnson, Marion, Morgan, Shelby
State residual	All other counties in Indiana 3/
Ohio	
Cincinnati SMSA	Clermont, Hamilton, Warren, Boone (Ky.), Campbell (Ky.), Kenton (Ky.), Dearborn (Ind.)
Cleveland SMSA	Cuyahoga, Geauga, Lake, Medina
Columbus SMSA	Delaware, Fairfield, Franklin, Madison, Pickaway
Youngstown SMSA	Mahoning, Trumbull
State residual	All other counties in Ohio
Wisconsin	
Milwaukee SMSA	Milwaukee, Ozaukee, Washington, Waukesha
State residual	All other counties in Wisconsin
West North Central	
Iowa	All counties
Missouri	
Kansas City SMSA	Cass, Clay, Jackson, Platte, Ray, Johnson (Ks.), Wyanndotte (Ks.)

2/ Except for Clinton, Madison, Monroe and St. Clair counties which are included in the St. Louis SMSA.

3/ Except for Dearborn county which is included in the Cincinnati SMSA.

Region, State, SMSA	Constituent counties
St. Louis SMSA	Franklin, Jefferson, St. Charles, St. Louis, St. Louis City, Clinton (Ill.), Madison (Ill.), Monroe (Ill.), St. Clair (Ill.)
State residual	All other counties in Missouri
South Atlantic	
Florida	All counties
Georgia	
Atlanta SMSA	Butts, Cherokee, Clayton, Cobb, De Kalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Newton, Paulding, Rock-dale, Walton
State residual	All other counties in Georgia
Maryland	
Baltimore SMSA	Anne Arundel, Baltimore, Carroll, Harford, Howard, Baltimore City
State residual	All other counties in Maryland
North Carolina	All counties
West Virginia	All counties
East South Central	
Alabama	All counties
Kentucky	All counties
Mississippi	All counties
West North Central	
Oklahoma	All counties
Texas	
Dallas-Fort Worth SMSA	Collin, Dallas, Denton, Ellis, Hood, Johnson, Kaufman, Parker, Rockwall, Tarrant, Wise
Houston SMSA	Brazoria, Fort Bend, Harris, Liberty, Montgomery, Waller
State residual	All other counties in Texas
Mountain	
None	

Region, State, SMSA	Constituent counties
Pacific	
California	
Los Angeles-Anaheim SMSA	Los Angeles, Orange
San Francisco-Oakland SMSA	Alameda, Contra Costa, Marin, San Francisco, San Mateo
San Jose SMSA	Santa Clara
State residual	All other counties in California

APPENDIX B

Multinomial Logit Model Results when Wage Rates are Specified as Total Payroll Divided by Worker-Hours of Total Labor.

Table B-1--Multinomial logit estimates and asymptotic t-ratios for the switchgear industry (SIC 3613) 2/

Dependent variable	Coefficient of									Number of observations
	Constant a	Prod. scale b_1	Wage rate b_2	Opp. cost b_3	Owner b_4	Size b_5	North-east b_6	North Central b_7	West b_8	
Closure	0.987 (.96)	-0.121 (-.78)	-0.291 (-1.29)	0.170 (.63)	-0.215 (-.97)	0.801 (2.81)	0.470 (1.66)	0.309 (1.02)	1.080 (2.41)	129
Relocation	-1.986 (-.97)	-.148 (-.45)	.412 (.92)	-.829 (-1.37)	-.267 (-.59)	-.406 (-.84)	-.438 (-.82)	-.472 (-.78)	-1.101 (-1.08)	21
Stationary contraction	-1.554 (-1.43)	.042 (.27)	.463 (1.97)	.047 (.17)	.445 (1.83)	-1.000 (-3.91)	-.208 (-.74)	-.172 (-.57)	-.996 (-1.92)	129
Stationary expansion	1.498 (1.41)	.225 (1.46)	-.417 (-1.77)	.423 (1.48)	.734 (2.84)	-.509 (-1.81)	.356 (1.19)	.500 (1.62)	.307 (.60)	117
Start 1/	1.055	.002	-.166	.190	-.696	1.114	-.180	-.164	.710	198

1/ t-ratios were not computed since establishment starts were used as the normalizing vector.
2/ Log likelihood -822.578.

Table B-2--Multinomial logit estimates and asymptotic t-ratios for the lighting fixtures industry (SIC 3642) 2/

Dependent variable	Coefficient of									Number of observations
	Constant a	Prod. scale b_1	Wage rate b_2	Opp. cost b_3	Owner b_4	Size b_5	North-east b_6	North Central b_7	West b_8	
Closure	1.630 (1.55)	0.035 (.23)	-0.120 (-.51)	0.157 (.52)	0.291 (1.70)	0.297 (1.19)	-0.241 (-.86)	0.163 (.48)	0.049 (.12)	467
Relocation	-1.826 (-.93)	-.521 (-1.61)	.289 (.67)	-1.340 (-1.91)	.391 (1.06)	.082 (.15)	.644 (1.03)	.018 (.02)	-.060 (-.07)	32
Stationary contraction	1.050 (.94)	.218 (1.33)	-.109 (-.44)	.488 (1.52)	.652 (3.45)	-.944 (-3.85)	.406 (1.28)	.508 (1.35)	-.025 (-.05)	309
Stationary expansion	1.709 (1.54)	-.021 (-.13)	-.217 (-.87)	.038 (.12)	.266 (1.45)	.147 (.55)	.046 (.15)	.436 (1.20)	.398 (.91)	279
Start 1/	-2.564	.289	.157	.656	-1.600	.418	-.855	-1.126	-.362	16

1/ t-ratios were not computed since establishment starts were used as the normalizing vector.
2/ Log likelihood -1316.05.

Table B-3--Multinomial logit estimates and asymptotic t-ratios for the consumer electronics industry (SIC 3651) 2/

Dependent variable	Coefficient of									Number of observations
	Constant a	Prod. scale b_1	Wage rate b_2	Opp. cost b_3	Owner b_4	Size b_5	North-east b_6	North Central b_7	West b_8	
Closure	-0.560 (-.54)	-0.147 (-.97)	0.335 (1.40)	-0.703 (-2.17)	-0.300 (-1.62)	0.597 (2.63)	-0.0003 (-.001)	0.487 (1.41)	-0.152 (-.37)	244
Relocation	-1.462 (-.56)	.011 (.03)	-.017 (-.03)	-.192 (-.25)	.288 (.58)	-.466 (-.87)	.499 (.67)	-.634 (-.65)	-.289 (-.26)	17
Stationary contraction	.495 (.39)	.363 (1.92)	-.245 (-.85)	1.166 (3.45)	.404 (1.69)	-.978 (-3.92)	-.028 (-.08)	.111 (.27)	-.604 (-1.15)	116
Stationary expansion	.204 (.16)	.005 (.02)	-.065 (-.22)	-.137 (-.35)	-.104 (-.45)	.303 (1.07)	-.049 (-.13)	.180 (.43)	.447 (.90)	102
Start 1/	1.324	-.232	-.008	-.134	-.288	.543	-.422	-.143	.598	303

1/ t-ratios were not computed since establishment starts were used as the normalizing vector.
2/ Log likelihood -1010.52.

Table B-4--Multinomial logit estimates and asymptotic t-ratios for the electronic systems and equipment industry (SIC 3662) 2/

Dependent variable	Coefficient of: Constant a	Prod. scale b_1	Wage rate b_2	Opp. cost b_3	Owner b_4	Size b_5	North-east b_6	North Central b_7	West b_8	Number of observa-tions
Closure	1.463 (2.35)	0.068 (.87)	-0.118 (-.91)	0.032 (.22)	-0.371 (-3.51)	0.404 (3.20)	-0.184 (-1.17)	-0.094 (-.49)	0.124 (.58)	864
Relocation	-6.449 (-3.56)	-.060 (-.28)	.819 (2.23)	-.728 (-1.78)	.723 (2.35)	-.244 (-.73)	.776 (1.66)	.309 (.53)	-.316 (-.50)	56
Stationary contraction	1.850 (2.55)	.187 (1.89)	-.311 (-2.02)	.381 (2.22)	.098 (.75)	-.884 (-6.36)	.151 (.81)	.025 (.11)	-.153 (-.58)	385
Stationary expansion	.982 (1.34)	-.025 (-.26)	-.177 (-1.14)	.151 (.88)	.026 (.20)	.063 (.40)	-.288 (-1.57)	-.060 (-.27)	-.039 (-.15)	358
Start 1/	2.154	-.170	-.213	.164	-.477	.661	-.454	-.180	.383	1,020

1/ t-ratios were not computed since establishment starts were used as the normalizing vector.
2/ Log likelihood -3551.24.

Table B-5--Multinomial logit estimates and asymptotic t-ratios for the electronic components industry (SIC 3679) 2/

Dependent variable	Coefficient of									Number of observations
	Constant a	Prod. scale b_1	Wage rate b_2	Opp. cost b_3	Owner b_4	Size b_5	North-east b_6	North Central b_7	West b_8	
Closure	1.377 (3.44)	0.073 (1.10)	-0.066 (-.76)	-0.111 (-1.00)	-0.143 (-1.70)	0.269 (2.54)	-0.326 (-2.49)	-0.546 (-3.58)	-0.002 (-.012)	1,237
Relocation	-3.660 (-3.47)	-.348 (-1.92)	.240 (1.09)	-.176 (-.60)	.174 (.75)	.089 (.32)	.938 (2.35)	.945 (2.15)	-.369 (-.65)	77
Stationary contraction	.151 (.32)	.251 (3.30)	.101 (.98)	-.139 (-1.04)	.328 (3.26)	-1.083 (-10.07)	.134 (.84)	.060 (.33)	-.223 (-1.02)	687
Stationary expansion	.927 (2.02)	.223 (3.00)	-.238 (-2.36)	.258 (2.05)	.049 (.50)	.258 (2.09)	-.152 (-1.02)	-.078 (-.46)	.082 (.40)	688
Start 1/	1.205	-.198	-.038	.167	-.408	.467	-.594	-.380	.512	1,309

1/ t-ratios were not computed since establishment starts were used as the normalizing vector.
2/ Log likelihood -5420.80.

Table B-6--Multinomial logit relationships: A summary for the electrical machinery industry 2/

Dependent variable	SIC code	Constant a	Prod. scale b_1	Wage rate b_2	Opp. cost b_3	Owner 3/ b_4	Size 4/ b_5	North-east b_6	North Central b_7	West b_8
		Sign and statistical significance of--								
Closure	3613	+	-	- *	+	-	+ ****	+ **	+	+ ***
	3642	+ *	+	-	+	+ **	+	-	+	+
	3651	-	-	+ *	- ***	- *	+ ****	-	+ *	-
	3662	+ ***	+	-	+	- ****	+ ****	-	-	+
	3679	+ ****	+	-	-	- **	+ ****	- ****	- ****	-
Relocation	3613	-	-	+	- *	-	-	-	-	-
	3642	-	- *	+	- **	+	+	+	+	-
	3651	-	+	-	-	+	-	+	-	-
	3662	- ****	-	+ ***	- **	+ ***	-	+ **	+	-
	3679	- ****	- **	+	-	+	+	+ ***	+ ***	-
Stationary contraction	3613	- *	+	+ ***	+	+ **	- ****	-	-	- ***
	3642	+	+ *	-	+ *	+ ****	- ****	+ *	+ *	-
	3651	+	+ ***	-	+ ****	+ **	- ****	-	+	-
	3662	+ ****	+ **	- ***	+ ***	+	- ****	+	+	-
	3679	+	+ ****	+	-	+ ****	- ****	+	+	-
Stationary expansion	3613	+ *	+ *	- **	+ *	+ ****	- **	+	+ *	+
	3642	+ *	-	-	+	+ *	+	+	+	+
	3651	+	+	-	-	-	+	-	+	+
	3662	+ *	-	-	+	+	+	- *	-	-
	3679	+ ***	+ ****	- ***	+ ***	+	+ ***	-	-	+
Start 1/	3613	+	+	-	+	-	+	-	-	+
	3642	-	+	+	+	-	+	-	-	-
	3651	+	-	-	-	-	+	-	-	+
	3662	+	-	-	+	-	+	-	-	+
	3679	+	-	-	+	-	+	-	-	+

1/ t-ratios were not computed since establishment starts were used as the normalizing vector.
2/ Levels of statistical significance for the two-tail t-test are denoted as follows: **** = 1-percent level; *** = 5-percent level; ** = 10-percent level; and, * = 20-percent level.
3/ Owner is a dummy variable taking the value 1 if the establishment is a single-unit operation, 0 otherwise.
4/ Size is a dummy variable taking the value 1 if the establishment has less than 100 employees, 0 otherwise.

*U.S. Government Printing Office: 1983— 380-932/ERS-1534

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